



## System Design

### Membrane System Design Guidelines for Midsize FilmTec™ Elements

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The following tables show the recommended guidelines for designing RO systems with 2.5- and 4-inch FilmTec™ Elements in light industrial, small commercial, and institutional applications, or for piloting large systems.

Light industrial systems in Table 1 have the same requirements as for large systems, requiring stable performance over several years. They are sometimes used for piloting large systems with continuous operation, CIP facilities, and no (or minimal) concentrate recirculation. The expected membrane lifetime is more than 3 years.

**Table 1: Design guidelines for FilmTec™ Elements in light industrial and small seawater applications**

| Feed Source                                | RO Permeate                                           | Well Water  | Softened Municipal | Surface     | Wastewater (filtered tertiary effluent) |              | Seawater                |             |
|--------------------------------------------|-------------------------------------------------------|-------------|--------------------|-------------|-----------------------------------------|--------------|-------------------------|-------------|
|                                            |                                                       |             |                    |             | MF <sup>1</sup>                         | Conventional | Well or MF <sup>1</sup> | Open Intake |
| Feed Silt Density Index (%/min)            | SDI < 1                                               | SDI < 3     | SDI < 3            | SDI < 5     | SDI < 3                                 | SDI < 5      | SDI < 3                 | SDI < 5     |
| Typical Target Flux, gfd (lmh)             | 22 (37)                                               | 18 (30)     | 16 (27)            | 14 (24)     | 13 (22)                                 | 11 (19)      | 13 (22)                 | 11 (19)     |
| Maximum Element Recovery (%)               | 30                                                    | 19          | 17                 | 15          | 14                                      | 12           | 15                      | 13          |
| Element Diameter                           | Maximum Permeate Flowrate, gpd (m <sup>3</sup> /d)    |             |                    |             |                                         |              |                         |             |
| 2.5-inch                                   | 800 (3.0)                                             | 700 (2.6)   | 600 (2.3)          | 500 (1.9)   | 500 (1.9)                               | 400 (1.5)    | 700 (2.6)               | 600 (2.3)   |
| 4.0-inch (except fullfits and LC products) | 2,200 (8.4)                                           | 1,800 (6.8) | 1,600 (6.0)        | 1,400 (5.4) | 1,300 (4.8)                             | 1,100 (4.1)  | 1,600 (6.0)             | 1,500 (5.7) |
| 4.0-inch diameter (LC products)            | 2,600 (10.1)                                          | 2,100 (8.2) | 1,900 (7.2)        | 1,700 (6.5) | 1,500 (5.7)                             | 1,300 (5.0)  | -                       | -           |
| Fullfit 4040                               | 2,500 (9.7)                                           | 2,000 (7.8) | 1,800 (6.9)        | 1,600 (6.2) | 1,400 (5.5)                             | 1,300 (5.0)  | -                       | -           |
| Element Type                               | Minimum Concentrate Flowrate, gpm (m <sup>3</sup> /h) |             |                    |             |                                         |              |                         |             |
| 2.5-inch diameter                          | 0.7 (0.16)                                            | 1 (0.2)     | 1 (0.2)            | 1 (0.2)     | 1 (0.2)                                 | 1 (0.2)      | 1 (0.2)                 | 1 (0.2)     |
| 4.0-inch diameter (except fullfits)        | 2 (0.5)                                               | 3 (0.7)     | 3 (0.7)            | 3 (0.7)     | 4 (0.9)                                 | 5 (1.1)      | 3 (0.7)                 | 4 (0.9)     |
| Fullfit 4040                               | 6 (1.4)                                               | 6 (1.4)     | 6 (1.4)            | 6 (1.4)     | 6 (1.4)                                 | 6 (1.4)      | -                       | -           |

**Membrane System  
Design Guidelines  
for Midsize  
FilmTec™  
Elements (cont.)**

| Element Type      | Maximum Feed Flowrate<br>gpm (m <sup>3</sup> /h) | Maximum Pressure Drop per Element<br>psig (bar) | Maximum Feed Pressure<br>psig (bar) |
|-------------------|--------------------------------------------------|-------------------------------------------------|-------------------------------------|
| Tape-wrapped 2540 | 6 (1.4)                                          | 13 (0.9)                                        | 600 (41)                            |
| Fiberglassed 2540 | 6 (1.4)                                          | 15 (1.0)                                        | 600 (41)                            |
| Seawater 2540     | 6 (1.4)                                          | 13 (0.9)                                        | 1,000 (69)                          |
| Tape-wrapped 4040 | 14 (3.2)                                         | 13 (0.9)                                        | 600 (41)                            |
| Fiberglassed 4040 | 16 (3.6)                                         | 15 (1.0)                                        | 600 (41)                            |
| Seawater 4040     | 16 (3.6)                                         | 15 (1.0)                                        | 1,000 (69)                          |
| Fullfit 4040      | 18 (4.1)                                         | 15 (1.0)                                        | 600 (41)                            |

<sup>1</sup> MF: Microfiltration – continuous filtration process using a membrane with pore size of < 0.5 micron.

<sup>2</sup> We recommend that the pressure drop for new/clean elements be at least 20% below the maximum.

Note: The limiting values listed above have been incorporated into the WAVE software. Designs of systems in excess of the guidelines results in a warning on the WAVE report.

In Table 2, the small commercial systems typically contain 1 – 6 elements that are either regularly replaced or cleaned (every half year or year) or performance loss is acceptable. The expected element lifetime is not more than 3 years. This is a low-cost, compact solution for intermittently operated systems.

**Table 2: Design guidelines for FilmTec™ Elements in small commercial applications**

| Feed Source                                                | RO Permeate  | Softened Municipal | Well Water  | Surface or Municipal Water |
|------------------------------------------------------------|--------------|--------------------|-------------|----------------------------|
| Feed Silt Density Index (%/min)                            | SDI < 1      | SDI < 3            | SDI < 3     | SDI < 5                    |
| Typical Target Flux, gfd (lmh)                             | 30 (51)      | 30 (51)            | 25 (42)     | 20 (34)                    |
| Maximum Element Recovery (%)                               | 30           | 30                 | 25          | 20                         |
| <b>Maximum Permeate Flowrate, gpd (m<sup>3</sup>/d)</b>    |              |                    |             |                            |
| 2.5-inch diameter                                          | 1,100 (4.2)  | 1,100 (4.2)        | 900 (3.4)   | 700 (2.7)                  |
| 4.0-inch diameter                                          | 3,100 (11.7) | 3,100 (11.7)       | 2,600 (9.8) | 2,100 (7.9)                |
| <b>Minimum Concentrate Flowrate, gpm (m<sup>3</sup>/h)</b> |              |                    |             |                            |
| 2.5-inch diameter                                          | 0.5 (0.11)   | 0.5 (0.11)         | 0.7 (0.16)  | 0.7 (0.16)                 |
| 4.0-inch diameter                                          | 2 (0.5)      | 2 (0.5)            | 3 (0.7)     | 3 (0.7)                    |

**Membrane System  
Design Guidelines  
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FilmTec™  
Elements (cont.)**

| Element Type      | Maximum Feed Flowrate<br>U.S. gpm (m <sup>3</sup> /h) | Maximum Pressure Drop per Element<br>psig (bar) | Maximum Feed Pressure<br>psig (bar) |
|-------------------|-------------------------------------------------------|-------------------------------------------------|-------------------------------------|
| Tape-wrapped 2540 | 6 (1.4)                                               | 13 (0.9)                                        | 600 (41)                            |
| Fiberglassed 2540 | 6 (1.4)                                               | 15 (1.0)                                        | 600 (41)                            |
| Seawater 2540     | 6 (1.4)                                               | 13 (0.9)                                        | 1,000 (69)                          |
| Tape-wrapped 4040 | 14 (3.2)                                              | 13 (0.9)                                        | 600 (41)                            |
| Fiberglassed 4040 | 16 (3.6)                                              | 15 (1.0)                                        | 600 (41)                            |
| Seawater 4040     | 16 (3.6)                                              | 15 (1.0)                                        | 1,000 (69)                          |

<sup>1</sup>We recommend that the pressure drop for new/clean elements be at least 20% below the maximum.

Note: The limiting values listed above have been incorporated into the WAVE software. Designs of systems in excess of the guidelines results in a warning on the WAVE report.

Excerpt from [FilmTec™ Reverse Osmosis Membranes Technical Manual](#) (Form No. 45-D01504-en), Chapter 3, "System Design."

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