



FILMTEC Membranes

Commercial Design Guidelines for Midsize FILMTEC™ Elements

The following tables show the recommended guidelines for designing RO systems with 2.5 and 4-inch FILMTEC elements in Light Industrial and Small Commercial applications.

Table 1. Design Guidelines for FILMTEC Elements in Light Industrial and Small Sea Water Applications

| Feed Source | RO Permeate | Well Water | Softened Municipal | Surface | Wastewater (Filtered Municipal Effluent) | | Seawater | |
|---|--|------------|--------------------|------------|--|--------------|-------------------------|-------------|
| | | | | | MF ¹ | Conventional | Well or MF ¹ | Open Intake |
| Feed Silt Density Index | SDI<1 | SDI<3 | SDI<3 | SDI<5 | SDI<3 | SDI<5 | SDI<3 | SDI<5 |
| Max. Element Recovery % | 30 | 19 | 17 | 15 | 14 ¹ | 12 | 13 | 10 |
| Typical Target Flux, gfd (l/m ² h) | 22 (37) | 18 (30) | 16 (27) | 14 (24) | 13 (22) | 11 (19) | 13 (22) | 11 (19) |
| Max. Permeate Flow Rate, gpd (m³/d) | | | | | | | | |
| 2.5-inch Diameter | 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 Diameter | 2300 (8.7) | 1900 (7.2) | 1700 (6.4) | 1500 (5.7) | 1400 (5.3) | 1200 (4.5) | 1800 (6.8) | 1500 (5.7) |
| Element Type | | | | | | | | |
| | Min. Concentrate Flow Rate, gpm (m³/h) | | | | | | | |
| 2.5-inch Diameter | 1 (0.2) | 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 Full-Fits) | 4 (0.9) | 4 (0.9) | 4 (0.9) | 4 (0.9) | 5 (1.1) | 6 (1.4) | 4 (0.9) | 5 (1.1) |
| Full-Fit 4040 | 6 (1.4) | 6 (1.4) | 6 (1.4) | 6 (1.4) | 7 (1.6) | 8 (1.8) | NA | NA |

| Element Type | Active Area ft ² (m ²) | Max. Feed Flow Rate | Max. Pressure Drop | Maximum Feed Pressure |
|----------------------|--|------------------------------|--|-----------------------|
| | | U.S. gpm (m ³ /h) | Per Element psig (bar) ² | psig (bar) |
| Tape-Wrapped 2540 | 28 (2.6) | 6 (1.4) | 13 (0.9) | 600 (41) |
| Fiberglassed 2540 | 28 (2.6) | 6 (1.4) | 15 (1.0) | 600 (41) |
| Seawater 2540 | 29 (2.7) | 6 (1.4) | 13 (0.9) | 1000 (69) |
| Tape-Wrapped 4040 | 82 (7.6) | 14 (3.2) | 13 (0.9) | 600 (41) |
| Fiberglassed 4040 | 82 (7.6) | 16 (3.6) | 15 (1.0) | 600 (41) |
| SW Fiberglassed 4040 | 80 (7.4) | 16 (3.6) | 15 (1.0) | 1000 (69) |
| Full-Fit 4040 | 85 (7.9) | 18 (4.1) | 15 (1.0) | 600 (41) |

¹ MF: Microfiltration - continuous filtration process using a membrane with pore size of <0.5 micron.

² 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 ROSA (Reverse Osmosis System Analysis) software. Design of systems in excess of the guidelines results in a warning message on the ROSA printout.

Note: System designer must thoroughly review Product Selection Guide before applying above information. For ultrapure applications refer to UPW System Design Guidelines.

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 | SDI<1 | SDI<3 | SDI<3 | SDI<5 |
| Max. Element Recovery % | 30 | 30 | 25 | 20 |
| Typical Target Flux, gfd (l/m ² h) | 30 (51) | 30 (51) | 25 (42) | 20 (34) |
| Max. Permeate Flow Rate, gpd (m³/d) | | | | |
| 2.5-inch Diameter | 1100 (4.2) | 1100 (4.2) | 900 (3.4) | 700 (2.7) |
| 4.0-inch Diameter | 3100 (11.7) | 3100 (11.7) | 2600 (9.8) | 2100 (7.9) |
| Min. Concentrate Flow Rate, U.S. gpm (m³/h)¹ | | | | |
| 2.5-inch Diameter | 0.5 (0.11) | 0.5 (0.11) | 1 (0.2) | 1 (0.2) |
| 4.0-inch Diameter | 2 (0.5) | 2 (0.5) | 4 (0.9) | 4 (0.9) |

| Element Type | Active Area ft ² (m ²) | Max. Feed Flow Rate U.S. gpm (m ³ /h) | Max. Pressure Drop Per Element psig (bar) ³ | Maximum Feed Pressure psig (bar) |
|----------------------|--|---|--|-------------------------------------|
| Tape-Wrapped 2540 | 28 (2.6) | 6 (1.4) | 13 (0.9) | 600 (41) |
| Fiberglassed 2540 | 28 (2.6) | 6 (1.4) | 15 (1.0) | 600 (41) |
| Seawater 2540 | 29 (2.7) | 6 (1.4) | 13 (0.9) | 1000 (69) |
| Tape-Wrapped 4040 | 82 (7.6) | 14 (3.2) | 13 (0.9) | 600 (41) |
| Fiberglassed 4040 | 82 (7.6) | 16 (3.6) | 15 (1.0) | 600 (41) |
| SW Fiberglassed 4040 | 80 (7.4) | 16 (3.6) | 15 (1.0) | 1000 (69) |

³We 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 ROSA (Reverse Osmosis System Analysis) software. Design of systems in excess of the guidelines results in a warning message on the ROSA printout.

Note: System designer must thoroughly review Product Selection Guide before applying above information. For ultrapure applications refer to UPW System Design Guidelines.

The factor which has the greatest influence on the membrane system design is the fouling tendency of the feed water. Membrane fouling is caused by particles and colloidal material which are present in the feed water and are concentrated at the membrane surface. 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 more frequent chemical cleaning. The Silt Density Index (SDI) value of the pretreated feed water correlates fairly well with the amount of fouling material present.

“Light Industrial” systems in Table 1 have the same requirements as for large systems, requiring stable performance over several years. They are typically for piloting large systems, with continuous operation, CIP facilities and none (or minimal) recirculation. The expected membrane lifetime is more than 3 years.

FILMTEC Membranes

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In Table 2, the "Small Commercial" systems are typically between 1-6 elements that are either regularly replaced or else 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.

The proposed limits are recommended guidelines based on many years of experience with FILMTEC membranes. If the fouling tendency of the feed water has been underestimated in the system design, the membranes will require more frequent cleaning, or the capacity of the system will decrease due to fouling. On the other hand, a

conservative approach is to anticipate a higher fouling tendency and enjoy a troublefree system operation and an increased membrane lifetime.

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