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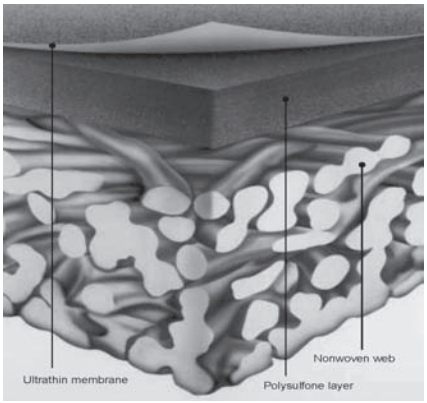
MEMBRANE DUPONT®

DUPONT® MEMBRANES

hytek | Hydrotecnologies

DESCRIZIONE MEMBRANE FILMTEC FT30 / FT30 MEMBRANE DESCRIPTION



Le membrane per osmosi inversa FILMTEC®FT30, sono membrane altamente performanti e disponibili in varie taglie e per molteplici applicazioni. Le FILMTEC FT30, sono adatte per trattare acque dolci, salmastre, di mare, di processo e tante altre applicazioni. Le membrane FILMTEC assicurano eccellenti performance in termini di flusso, alte reiezioni saline, e un' ottima resistenza agli inquinamenti microbiologici. FT30, possono operare in un largo range di pH (2 - 11), sono compatte, resistenti e sono anche disponibili per applicazioni con alte temperature (al di sopra dei 45°C). Le membrane FILMTEC FT30, sono presenti in tutto il mercato mondiale sin dal 1980 e ad oggi possiamo affermare che la loro alta qualità è comprovabile e riconosciuta da tutti gli operatori che operano nel settore del trattamento delle acque. Possiamo elencare le tante peculiarità tecniche riconosciute, quali: alta reiezione salina (si attesta generalmente al 99.5%), flussi di 24 l/h/m2 e addirittura su soluzioni al 0.2% alla pressione di 225 psi (15.5 bar) si ottengono ordinariamente reiezioni ben al di sopra del 99% con flussi di 51 l/h/m2.
Severi test ripetuti ci hanno confermato i dati appena esposti. Test prolungati per tre anni su acque con temperatura media di 25°C, 3000 ppm di TDS ad una pressione di 350 psi (24 bar), hanno confermato l' altissima qualità delle membrane , non riscontrando segni di deterioramento o compattazione. Molte sono anche le applicazioni su acque di mare, in particolar modo su imbarcazioni, dove anche qui in tre anni di esercizio intermittente, non si sono avvisate sostanziali perdite di performance. Le membrane FILMTEC, sono conformi a quanto prescritto dalla FDA (Food Additive Regulation 21CFR 177.2550) e quindi idonee al contatto con acque destinate a venire a contatto con alimenti.

Composizione del film sottile

La membrana semipermeabile FT30, è composta da tre strati: un supporto in poliestere, la membrana in polisulfone FT30 e una barriera ultra fine che riveste la superficie filtrante (vedi figura sopra).

Descrizione della membrana FT30

Il principale supporto della membrana e dato da un a fibra opportunamente calandrata per rendere la superficie più rigida, liscia e senza impurità (FT30). Siccome la fibra in poliestere rimane comunque un materiale troppo irregolare e poroso per poter offrire un sub strato di supporto al layer semipermeabile, gli viene incastonato sopra uno strato microporoso di polisulfone. Il polisulfone è un materiale straordinario e performante, in quanto ha una superficie molto regolare e uno spessore di circa 150 Angstroms. La membrana FT30, con il suo spessore di circal 2000 Angstroms, offre un' ottima resistenza contro le sollecitazioni meccaniche dovute alla pressione, solo però se opportunamente abbinata al polisulfone. FT30 ha anche una buona resistenza chimica e contro la deteriorazione batterica. Occorre tuttavia preservare sempre la membrana FT30 da eventuali proliferazioni batteriche dovute a stoccaggi prolungati. Una procedura ottimale di conservazione, è quella di immergere la membrana in una soluzione di metabisolfito di

FILMTEC®FT30 thin-film composite reverse osmosis (RO) membrane gives excellent performance for awide variety of applications, including low-pressure tap water use, single-pass seawater and brackish water desalination, chemical processing, and waste treatment.
This membrane exhibits excellent performance interms of flux, salt rejection, and microbiological resistance.
FT30 elements can operate over a pH range of 2 to 11, are resistant to compaction, and are suitable for temperatures up to 45°C. FILMTEC spiral-wound elements of FT30 membrane have been extensively used since 1980 both in the United States and abroad.
Innumerous installations under actual seawater conditions, FT30 element shave provided salt rejections of better than 99.5 percent and fluxes of 10 gfd (24 l/h m2).
On a 0.2 percent salt solution at 225 psi (1.6 MPa), rejections above 99 percent and fluxes of 26 gfd (51 l/h m2) are routinely obtained.
Several long-term tests have been completed. A continuous three-year test operating at about 25°C and 350 psi on 3000 ppm feed did not show any membrane compaction or deterioration in salt rejection.
Elements have also operated in shipboard seawater systems with normal intermittent use for over three years with no significant loss in performance.
FILMTEC FT30 thin-film composite RO membrane complies with Food Additive Regulation 21CFR 177.2550 for use in processing foods and purifying water for food applications.

Thin-Film CompositeConfiguration

The membrane composite consists of three layers: a polyester support web, a microporous polysulfone interlayer, and an ultrathin barrier coating on the top surface. A schematic diagram of themembrane is shown above.

Description of the FT30 Membrane

The major structural support is provided by the nonwoven web, which has been calendered to produce a hard, smooth surface freeof loose fibers. Since the polyester web is too irregular and porous to provide a proper substrate for the salt barrier layer, a microporous layer of engineering plastic (polysulfone) is cast on to the surface of the web. The polysulfone coating is remarkable in that it has surface pores controlled to a diameter of approximately 150 angstroms. The FT30 barrier layer, about 2000 angstroms thick, can with stand high pressures because of the support provided by the polysulfone layer. Because of its barrier layer thickness, FT30 is very resistant to mechanical stresses and chemical degradation. Biological Protection and DisinfectionVarious storage tests have been conducted on FT30 elements to determine biological protection procedures. The best procedure recommended for storage is to immerse the element in a protective solution which contains 1.5 percent (by weight) sodium metabisulfite (food grade). This treatment

sodio (alimentare) all' 1.5% in peso. E' possibile effettuare anche disinfezioni con cloro ma è vivamente sconsigliato. La FT30 è inoltre resistente alle cloroammine e ai clorocianurati, tuttavia questi composti non hanno un eficace proprietà disinfettante. Il biossido di cloro puro, può essere impiegato a concentrazioni di 500 ppm a condizione che il tempo di stoccaggio non sia superiore a 1 settimana.
Il biossido di cloro tuttavia non è un biocida performante, soprattutto nel lungo periodo. La membrana FT30, è permeabile al biossido di cloro e alle cloroammine; infatti residui di questi due elementi si possono ritrovare nel permeato. L' unico limite rappresentato dalla membrana FILMTEC FT30, è quello dell' intolleranza al cloro libero.
Com' è risaputo, l' attacco del cloro e più lento a pH e acido, mentre diventa rapido a pH alcalini. Tuttavia il contatto della membrana FILMTEC con cloro libero, non porta immediatamente alla sua degradazione, ma può portarla con un contatto prolungato.
Disinfettanti alternativi che possono essere impiegati tranquillamente, sono il perossido di idrogeno e l' acido peracetico a concentrazioni sopra allo 0.2% a bassa temperatura.
Il contatto prolungato con il perossido di idrogeno potrebbe danneggiare la membrana.
Il solfato di rame può essere utilizzato per prevenire la formazione di alghe. Iodio, germicidi quaternari e composti fenolici, non devono essere impiegati in quanto i test hanno rilevato una diminuzione dei flussi.

Lavaggi

Grazie alla grande stabilità alle variazioni di ph e temperatura, la membrana FT30 non solo è idonea ai lavaggi chimici, ma questi vengono effettuati con ottimi risultati. I prodotti chimici acidi ed alcalini, possono essere utilizzati fino ad una temperatura massima di 50°C. Si possono utilizzare prodotti acidi quali: acido fosforico, acido cloridrico, acido solforico, acido nitrico e acido citrico. I prodotti basici invece, vengono utilizzati per la rimozione di sostanze organiche e il prodotto più utilizzato in assoluto rimane l' idrossido di sodio. I tensioattivi anionici possono essere usati per lavaggi alcalini mentre i tensioattivi cationici (come dimostrato da test di laboratorio) provocano una diminuzione irreversibile dei flussi e quindi devono essere evitati. I tensioattivi non ionici possono essere utilizzati sporadicamente ma la procedura di lavaggio è delicata e potrebbe compromettere le performance dell' impianto (prego contattare l' ufficio tecnico Hytek per ulteriori delucidazioni).

Declorazione dell' acqua di alimento

Da anni ormai, l' ipoclorito di sodio viene utilizzato per la disinfezione contro gli agenti patogeni sia per le acque industriali, che per le acque municipali.
Il largo uso dell' ipoclorito, è dovuto in gran parte alla facile reperibilità, al costo contenuto e alla sua malleabilità e non pericolosità. L' effettiva efficienza del Cl_2, è legata a tre fatori imprescindibili quali: concentrazione, tempo di contatto e pH dell' acqua. Per acque potabili, esso generamente viene adoperato in concentrazioni di 0,5 mg/l come cloro residuo, mentre si preferiscono tenori leggermente più alti (oscillanti tra lo 0.5 e 1 mg/l), per le acque destinate ad altri utilizzi (filtri a sabbia, scambiatori di calore ecc). Quando la membrana FT30 FILMTEC viene utilizzata per impianti di osmosi inversa, l' acqua in alimento deve essere priva di cloro e quindi spesso si necessita di un pre-trattamento di declorazione. L' eventuale prolungato contatto con cloro, porta la FT30 alla sua ossidazione. Il tempo massimo di contatto con cloro stabilito con test di laboratorio, si aggira all' incirca in 1.000 ppm di cloro libero all' ora, dopo di che si inizierà ad osservare una perdita sulla reiezione salina. Tempi di contatto minori a concentrazioni inferiori, non causano un degradamento immediato della membrana, tuttavia questo potrà

maintains initial membrane flux and performance. Disinfection with chlorinating agents can be practiced within limits but is not recommended. TheFT30 membrane is resistant to chloramine, chloramine-T, N-chloroisocyanurates to the extent that these mild agents can be used, but their disinfectant properties are not very great. Pure chlorine dioxide can be used successfully at 500 ppm concentration if the storage period is less than one week, but it is not an effective biocide for longer periods. Chlorine dioxide that is generated onsite from chlorine and sodiumchlorate is always contaminated with free chlorine, which attacks the membrane. The FT30 membrane is permeable to chloramine and to chlorine dioxide. Either of these will pass through the membrane resulting in a small residual disinfectant in the permeate. The membrane has only limited resistance to free chlorine. Chlorine attack is slowest at neutral and acidic pH levels and fastest at alkaline pH levels. It is noteworthy, however, that short-term exposure of the membrane to chlorine does not destroy the membrane. Thus, it canbe used effectively in installations where system up sets may result intemporary exposure of the membrane to free chlorine. Alternative disinfectants that may be used are hydrogen peroxide and peracetic acid. Hydrogen peroxide or peracetic acid can be used at concentrations up to 0.2 percent at 25°C as specified in the warranty on FILMTEC membranes but not at higher temperatures. Continuous exposure to hydrogen peroxide at this concentration will eventually damage the membrane. Copper sulfate can be used to control algae growth. Iodine, quaternary germicides, and phenolic compounds should not be used as tests show that all of these agents cause flux losses.

Cleaning

Because of the FT30 membrane's combination of pH stability and temperature resistance, cleaning can be done very effectively. Both acidic and alkaline cleaners can be used at temperatures to 50°C. Acid cleaningto remove mineral scale is best done at pH 2 or lower with phosphoric, hydrochloric, sulfamic or nitric acid.
Citric acid can also be used. Alkaline cleaning to remove organic fouling is generally done with sodium hydroxide and sodium lauryl sulfate. Various combinations of agents such as sodium EDTA, sodiumtripolyphosphate, and trisodiumphosphate can also be used. Generally, anionic surfactants can be used for alkaline cleaning. Cationic surfactants cause an irreversible fluxloss and must be avoided.
Non ionic surfactants can sometimes be used, but they must be used sparingly and thoroughly rinsed out before the membrane is pressurized (please contact Hytek technical office for more information).

Dechlorinating FeedwaterChlorine

Cl2 has been used for many years to treat municipal and industrial water and waste waters as a disinfectant because of its capacity to inactivate most pathogenic microorganisms quickly.
The effectiveness of Cl2 is dependent on the Cl2 concentration, time of exposure, and the pH of the water.
Chlorine is used for the disinfection of potable water where a residual chlorine concentration near 0.5 mg/l is commonly used. In a water treatment scheme, fouling of water intake lines, heat exchangers, sand filters, etc., may be prevented by maintaining a free Cl2 residual of 0.5-1.0 mg/l.
When FILMTEC®FT30 thinfilm composite membrane is used in the reverse osmosis (RO) process, the RO feed must be dechlorinated to prevent oxidation of the membrane. FT30 membrane has a chlorine tolerance of up to 1,000 ppm-hours before noticeable loss of salt rejection is observed. If dechlorination up sets occur and if corrected in a timely manner, membrane damage can be minimized.

Definitions and Chemistry .

Residual chlorine. Refers to the total amount of chlorine ("combined"and "free available" chlorine) remaining in the

potenzialmente avvenire col tempo.

Chimica e definizioni

Cloro residuo. Di riferisce al valore totale di cloro presente nell' acqua al momento della misurazione, ed è dato dalla sommatoria del cloro libero più quello totale.

Cloro combinato.

Un composto che si lega con il cloro e che spesso si può trovare nell' acqua, sono le cloro-ammine.

Esse derivano da un legame tra cloro ed ammoniaca.

Cloro libero

Di norma il cloro libero, si forma dalla presenza nell' acqua di acido ipocloroso, dallo ione ipoclorito oppure dalla presenza di tutte due insieme. Il cloro libero è strettamente legato alle variazioni di pH e temperatura. Generalmente il cloro libero si trova dopo che è stata esaurita la domanda dello ione ammonio presente nell' acqua.

Considerazioni gestionali

Il cloro per la disinfezione delle acque è utilizzabile in varie forme: ipoclorito di calcio, ipoclorito di sodio e cloro gas. I costi di investimento, quelli di gestione, la facilità all' uso e la tipologia d' impianto, sono i fattori predominanti che inducono il progettista alla scelta più idonea. Se un' acqua osmotizzata viene successivamente clorata, occorrerà accertarsi che questa non ritorni a contatto con le membrane RO e bisognerà sempre prevedere dei sistemi di monitoraggio e di non ritorno sull' acqua permeata.

Cloroammine

Gli studi scientifici hanno dimostrato che il cloro reagisce con i composti organici presenti nell' acqua potabile per produrre una varietà di trialometani. (THMs). Esami tossicologici hanno dimostrato come questi THMs siano cancerogeni, fissando un limite per le acque potabili di 100 ppb. Per prevenire e ridurre la loro formazione, occorre stabilire una disinfezione a valle ed è possibile l' impiego di cloroammine. Le cloroammine non generano THMs, tuttavia occorre sottolineare il basso potenziale disinfettante del composto e gli studi ancora incerti sull' effetto che questo può avere sulla salute umana. Tale composto è dato da una serie di reazioni chimiche tra HCLO e ammoniaca, formando cloroammina inorganica.

Test di laboratorio hanno stabilito che la membrana FT30 ha una tolleranza alle cloroammine di circa 300.000 ppm/ora sopra la quale si renderà necessaria una declorazione. Occorre considerare che la presenza di cloro ammine può portare alla formazione di cloro libero il quale, come si è già detto, è deleterio se viene a contatto prolungato con la FT30.

Declorazione

- Carboni attivi
- Metabisolfito di sodio

Procedure di lavaggio delle membrane FILMTEC FT30

Di seguito riportiamo una serie di procedure raccomandate per i lavaggi chimici delle membrane FT30 . Si ricorda che un impianto RO ben dimensionato, non necessita di frequenti lavaggi chimici, tuttavia, grazie all' ampio range di pH di funzionamento delle FT30, questi possono essere eseguiti tranquillamente ed efficacemente. FILMTEC FT30 può lavorare in una combinazione ottimale tra ampi range di pH e resistenza alle alte temperature.

Requisiti per il lavaggio chimico

Nei sistemi ad osmosi inversa durante l' esercizio dell' impianto, le membrane possono essere inquinate da vari elementi: precipitazione di materiale inorganico, materiale biologico, particelle colloidali e composti organici. Tali elementi tendono con il tempo a stratificarsi sopra la membrana semipermeabile causando perdite di flusso, peggioramento della reiezione salina, perdite di carico ecc. Le membrane dovrebbero essere lavate quando il flusso normalizzato del permeato scende al di sotto del 10%, o il passaggio salino normalizzato cresce di un 5%, o ancora quando la perdita di carico cresce del 15%

water at the time of measurement.

Combined available chlorine.

Refers to one or more of the family of chlorineammonia compounds, called chloramines, resulting from the reaction of chlorine with ammonia compounds present in the water.

Free available chlorine.

This form is actually hypochlorousacid, hypochlorite ion or a mixture of the two, depending on pH and temperature. Free chlorine is usually present after sufficient chlorine has been added to satisfy the demand of ammonium ions present.

Engineering Considerations

Chlorine is most commonly availableas hypochlorites of calcium and sodium or chlorine gas.

Capital cost, operating cost and water chemistry will be the predominate factors in deciding which type of system to use. If the product water from an RO system is chlorinated, care must be exercised to insure that the chlorine does not diffuse back into the membrane. Air breaks, check valves, etc., should be employed appropriately.

Chloramines

Studies have demonstrated that chlorine reacts with organic compounds present in drinking water to produce a variety of trihalomethanes (THMs).

Toxicological investigation shave implicated certain THMs as carcinogens.

The EPA has established a maximum THM contaminate level of 100 ppb for drinking water.

To meet this requirement, many water facilities have sought to reduce levels of THMs.

This can be done by using chloramine as a disinfectant. Chloramine does not generate THMs.

However, considerable controversy has a risen concerning the efficiency of chloramine disinfection and its potential health effects.

In aqueous solution, HOCl reacts with ammonia to form inorganic chloramines in a series of step wise reactions.

These reactions are governed primarily by pH and chlorine-to-nitro-gen weight ratio.

FILMTEC FT30 membrane has a 300,000 ppm hour tolerance for chloramine, which implies that dechlorination is not required. However, since chloramines are formed by adding ammonia to chlorine, it is possible that free chlorine will be present. Since this free chlorine can be damaging to the membrane, dechlorination should still be considered.

Dechlorination

- Activated carbon.
- Sodium metabisulfite.

Cleaning Procedures for FILMTEC FT30 Elements

The following are general recommendations for cleaning FILMTECTM FT30 elements. More detailed procedures for cleaning an RO system are typically included in the operating manual provided by the system supplier. It should be emphasized that frequent cleaning is not required for a properly designed and properly operated RO system, however because of the FT30 membrane's unique combination of pH range and temperature resistance, cleaning can be accomplished very effectively.

Cleaning Requirements

In normal operation, the membrane in reverse osmosis elements can become fouled by mineral scale, biological matter, colloidal particles, and insoluble organic constituents. Deposits build up on the membrane surfaces during operation until they cause loss innormalized permeate flow, loss of normalized salt rejection, or both. Elements should be cleaned when ever the normalized permeate flow drops by =10 percent, or the normalized salt passage increases by = 5 percent, or the normalized differential pressure (feed pressure minus concentrate pressure) increases by =15 percent from the reference condition established during

rispetto a quella registrata nelle prime 48 ore di funzionamento dell' impianto. La differenza di pressione dovrebbe sempre essere controllata tra uno stadio e l' altro. Se gli spaziatori interni alla membrana FT30 inizieranno a sporcarsi, la perdita di carico inizierà ad aumentare. Si fa presente che la produzione del permeato decresce con il diminuire della temperatura. Questa è una condizione normale e non è sintomo di sporcamento. Una cattica conduzione degli impanti di pre-trattamento, degli strumenti di controllo, o l' aumento del recupero, possono causare una diminuzione della produzione e un' aumento del passaggio salino sul permeato.

Precauzioni di sicurezza

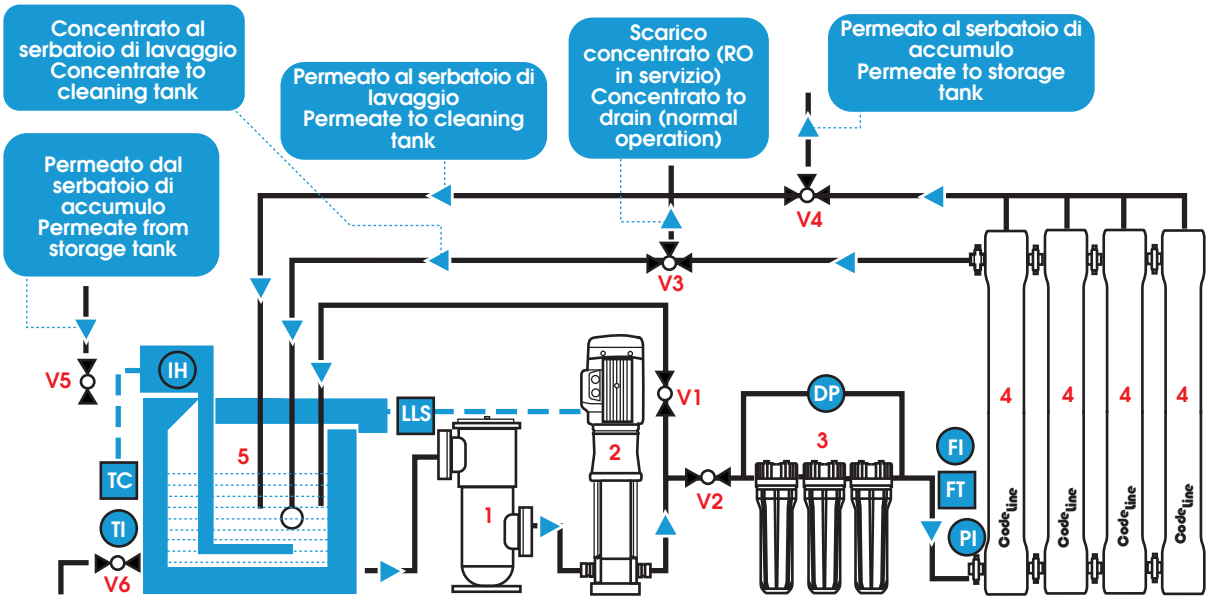
1. Quando si utilizza del prodotto chimico, consultare sempre le sue schede di sicurezza rilasciate dal produttore ed eseguirle scrupolosamente.
2. Quando si prepara la soluzione di lavaggio, assicurarsi che il prodotto sia ben diluito e miscelato prima di iniziare il ricircolo all' interno delle FT30.
3. E' vivamente raccomandato dopo il lavaggio, flussare le membrane con un' acqua di buona qualità esente da cloro libero (a 20°C minimo di temperatura). E consigliata l' acqua osmotizzata, tuttavia l' acqua di rete esente da cloro o l' acqua proveniente dall' impianto di pre-filtrazione potrebbe andare bene, verificando prima che non sussistano condizioni corrosive per le tubazioni. Una particolare attenzione va impiegata durante la fase iniziale del lavaggio, operando a bassi flussi e pressioni ridotte per agevolare la miscelazione del prodotto chimico con lo sporco presente sulle membrane. Dopo il lavaggio, e prima di mettere in funzione l' impianto, si deve scartare il permeato per almeno 10 minuti (causa presenza di chemicals).
4. Durante il ricircolo del prodotto chimico, la temperatura non deve essere superiore ai 50°C a pH 2-10, 35°C a pH 1-11 e 30°C a pH 1-12.
5. Con le membrane avente un diametro superiore a 6", la direzione del flusso di lavaggio deve essere la stessa dell' esercizio, questo per evitare delle telescopizzazioni . Questo è vivamente raccomandato anche per le membrane più piccole.

Di seguito uno schema tipico di un impianto di lavaggio chimico

the first 48 hours of operation. Differential Pressure should be measured and recorded across each stage of the array of pressure vessels. If the brine channels within the element become plugged, the pressure drop will increase. It should be noted that the permeate flux will drop if feed water temperature decreases. This is normal and does not indicate membrane fouling. A malfunction in the pretreatment, pressure control, or increase in recovery can result in reduced product water output or an increase in salt passage. If a problem is observed, these causes should be considered first. The element(s) may not require cleaning.

Safety Precautions

1. When using any chemical follow accepted safety practices. Consult the chemical manufacturer for detailed information about safety, handling and disposal.
2. When preparing cleaning solutions, ensure that all chemicals are dissolved and well mixed before circulating the solutions through the elements.
3. It is recommended the elements be flushed with good-quality chlorine-free water (20°C minimum temperature) after cleaning. Permeate water is recommended; but a dechlorinated potable supply or pre filtered feed water may be used, provided that there are no corrosion problems in the piping system. Care should be taken to operate initially at reduced flow and pressure to flush the bulk of the cleaning solution from the elements before resuming normal operating pressures and flows. Despite this precaution, cleaning chemicals will be present on the permeate side following cleaning. Therefore, the permeate must be diverted to drain for at least 10 minutes or until the water is clear when starting up after cleaning.
4. During recirculation of cleaning solutions, the temperatures must not exceed 50°C at pH 2-10, 35°C at pH 1-11, and 30°C at pH 1-12.
5. For elements greater than six inches in diameter, the flow direction during cleaning must be the same as during normal operation to prevent element telescoping, because the vessel thrust ring is installed only on the reject end of the vessel. This is also recommended for smaller elements. Equipment for cleaning is illustrated below.



1 = Filtro di sicurezza100ø/Security Screenfi100 mesh
2 = Pompa bassa pressione in acciaio o in materiale non metallico/Low-Pressure Pump, 316 SS ornon-metallic composite
3 = Filtri a cartuccia da 20-10-5ø in PVC, FRP o acciaio /Cartridge Filter, 5-10 micron polypropylene with PVC, FRP, or SS housing
4 = Sistema RO con vessels CodeLine / RO unit with CodeLine vessels
5 = Vasca per lavaggio chimico in PP o FRP con agitatore / Chemical Mixing Tank, polypropylene or FRP

TC = Strumento per il controllo della temperatura / Temperature Control

TI = Indicatore di temperatura Temperature Indicator
IH = Riscaldatore ad immersione / Immersion Heater
LLS = Livello di minima per interruzione pompa / Lower Level Switch to shut off pump
DP = Indicatore differenziale di pressione / Differential Pressure Gauge
FI = Flussimetro / Flow Indicator
FT = Trasmettitore di flusso (opzionale) / Flow Transmitter (optional)

PI = Manometro / Pressure Indicator
V1 = Valvola per ricircolo pompa in CPVC / Pump Recirculation Valve, CPVC
V2 = Valvola regolazione portata in CPVC /Flow Control Valve, CPVC
V3 = Valvola 3 vie per concentrato in CPVC / Concentrate Valve, CPVC 3-way valve
V4 = Valvola 3 vie per permeato in CPVC / Permeate Valve, CPVC 3-way valve
V5 = Valvola d' ingresso permeato in CPVC / Permeate Inlet Valve, CPVC
V6 = Valvola di scarico serbatoio di lavaggio in PVC o CPVC / Tank Drain Valve, PVC, or CPVC

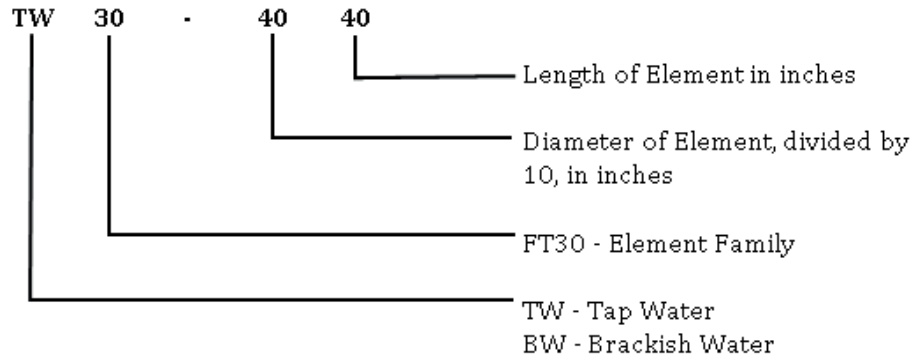
Caratteristiche della membrana
Le membrane FILMTEC ™ coprono una vasta gamma di applicazioni. Si caratterizzano dal tipo di membrana, involucro esterno, dimensioni e prestazioni. La nomenclatura delle membrane FILMTEC ™ u in grado di fornire alcune di queste informazioni.

Nomenclatura
Le membrane con diametro inferiore a 8 pollici, sono identificate come da Tabella 1. La prima parte del nome indica la membrana e il suo uso tipico; ad esempio, BW30 e' una membrana FT30 per acqua salmastra utilizzata appunto per acqua salmastra. La seconda parte del nome indica la dimensione dell'elemento; per esempio 2540 e' un elemento con un diametro di 2,5 pollici e una lunghezza di 40 pollici.Di seguito si riporta come esempio la nomenclatura delle FILMTEC ™

Element Characteristics
FILMTEC™ elements cover a wide range of applications. They can be characterized by membrane type, outer wrap, size and performance. The nomenclature of FILMTEC™ elements provides some of this information.

Nomenclature
Elements less than 8 inches in diameter are named according to Table 1. The first part of the name indicates the membrane and its typical use; for example, BW30 is a Brackish Water FT30 membrane used for brackish water. The second part of the name indicates the element size; for example 2540 is an element with a diameter of 2.5 inches and a length of 40 inches.
The element nomenclature for FILMTEC™ elements is for example as follows:

Figura a / Figure a



Le membrane da 8 pollici hanno sempre un diametro da 8 pollici e una lunghezza di 40 pollici. Sono denominati in base all'effettiva area attiva espressa in piedi quadrati, ad es. l'elemento BW30-400 ha un'area attiva di 400 piedi quadrati. Ad alcuni tipi di membrane, viene data un'estensione al loro nome, ad esempio FF o FR. Questi significano che le membrane hanno caratteristiche seciali:
FR: Resistente allo sporcamento
FF: per applicazioni sanitarie

Membrana
Le seguenti tipologie di membrana vengono utilizzate per produrre le FILMTEC ™:
• NF270 - membrana nanofiltrazione ad alta produttivita' per rimozione di organici con medio passaggio salino e della durezza
• NF200 - membrana per nanofiltrazione con alta reiezione su atrazina e TOC e passaggio medio di calcio
• NF90 - membrana per nanofiltrazione con rimozione del 90% di sale, elevata rimozione di ferro, pesticidi, erbicidi e TOC
• NF - membrana per nanofiltrazione utilizzata in fluidi differenti dall' acqua
• TW30 - Membrana FT30 per acqua salmastra ad alta reiezione, generalmente utilizzata per applicazioni su acqua di acquedotto.
• TW30LP - Versione a bassa pressione della membrana TW30
• BW30 - Membrana FT30 per acqua salmastra ad alta reiezione per acque salmastre
• RO - Membrana ad osmosi inversa utilizzata per applicazioni sanitarie
• HSRO - membrane sanitizabili a caldo utilizzate in cambinzione con la caratteristica "Fullfiit"
• BW30LE - Versione a bassa pressione delle BW30
• SG30 - Membrana FT30 per semiconduttori per la produzione di acqua ukta pura
• SG30LE - Versione a bassa pressione delle SG30
• XLE - Membrana RO a bassissima pressione (la piu' bassa della gamma) per appicazioni su acqua salmastra
• SW30 - Membrana acqua mare, generalmente utilizzata per bassa salinita o acqua mare fredda e acqua salmastra con alta salinita
• SW30HR - Membrana SeaWater ad alta reiezione, generalmente utilizzata per la desalinizzazione di acqua di mare a singolo passo
• SW30HRLE - Membrana acqua mare ad alta reiezione, tipicamente utilizzata a bassa pressione su acqua di mare
• SW30XLE - membrana per la dissalazione di acqua di mare a bassissima pressione

Dimensione dell'elemento
La lunghezza standard di una membrana e' di 40 pollici (1.016 mm). Per sistemi piu' piccoli sono disponibili elementi piu' corti, come 35 pollici (356 mm) e 533 mm (2133).

Eight-inch elements are always 8 inches in diameter and 40 inches in length. They are named according to the actual active membrane area in square feet, for example the BW30-400 element has an active membrane area of 400 square feet.
Some elements types have an extension to their name, e.g., FF or FR. These stand for special element or membrane features:
FR: Fouling Resistant
FF:Fullfit

Membrane
The following membrane types are used with FILMTEC™ elements:
• NF270 – high productivity nanofiltration membrane for removal of organics with medium salt and hardness passage
• NF200 – nanofiltration membrane for high atrazine and TOC rejection, medium calcium passage
• NF90 – nanofiltration membrane for 90% salt removal, high removal of iron, pesticides, herbicides, TOC
• NF – nanofiltration membrane used in non-water applications
• TW30 – High rejection brackish water FT30 membrane, typically used for Tap Water RO
• TW30LP – Low Pressure version of the TW30 membrane
• BW30 – High rejection Brackish Water FT30 membrane for brackish water RO
• RO – Reverse Osmosis membrane used in fullfit elements for sanitary applications
• HSRO – Heat Sanitizable version of the RO membrane used in fullfit elements
• BW30LE – Low Energy version of the BW30 membrane
• SG30 – Semiconductor Grade FT30 membrane for ultrapure water RO
• SG30LE – Low Energy version of the SG30 membrane
• XLE – EXtremely Low Energy RO membrane for lowest pressure brackish water RO
• SW30 – SeaWater RO membrane, typically used for low salinity or cold seawater RO and high salinity brackish water RO
• SW30HR – SeaWater RO membrane with High salt Rejection, typically used for single pass seawater desalination
• SW30HRLE - SeaWater RO membrane with High salt Rejection, typically used for Low Energy seawater desalination
• SW30XLE – membrane for SeaWater desalination with eXtremely Low Energy consumption

Element Size
The standard length of a membrane element is 40 inches (1,016 mm). For small and compact systems shorter elements are available, such as 14 inches (356 mm) and 21 inches (533

Le membrane RO per utilizzo domestico (acqua potabile) sono lunghe12 pollici con un diametro di 1,8 pollici e si adattano ai principali vessels in commercio con un diametro interno nominale di 2 pollici. Il diametro standard delle membrane FILMTEC ™ e' di 2,5, 4 e 8 pollici (61 - 99 - 201 mm) e sono idonei per essere adattati ai pressure vessels con diametro nominale di 2,5, 4 e 8 pollici.

Avvolgimento esterno

L'involucro esterno delle membrane FILMTEC ™ puo' essere costituito da un nastro, da fibra di vetro o da un reticolato in polipropilene. Per applicazioni domestiche su acqua potabile, vengono utilizzate membrane avvolte da un nastro, per tutti gli altri elementi, ad eccezione dei Fullfit, vengono avvolti da fibra di vetro. La fibra di vetro conferisce una maggiore resistenza fisica per poter funzionare anche nelle situazioni piu' critiche. le membrane Fullfit sono costruite con un bypass in grado di ridurre al minimo le aree stagnanti; tali elementi sono ottimali per le applicazioni sanitarie.

Performance delle membrane

Le prestazioni tecniche e dimensionalli di tutte membrane della FILMTEC ™ sono riportate nelle relative schede tecniche riportate di seguito. Una panoramica generale e' visionabile nella successiva tabella 1.

mm).

Home Drinking Water RO elements are 12 inches long and 1.8 inches in diameter to fit into nominal 2-inch I.D. housings.

The standard diameter of FILMTEC™ elements is 2.5, 4 and 8 inches (61 – 99 – 201 mm). They are sized to fit into 2.5, 4 and 8 inch pressure vessels respectively.

Element Outer Wrap

The outer wrap of FILMTEC™ elements is tape, fiberglass or a polypropylene mesh. Tap water and home drinking water RO elements are tape-wrapped, all other elements except fullfit elements are fiberglass wrapped. Fiberglass adds more physical strength to the element for operation under harsh conditions.

Fullfit elements have a designed bypass during operation to minimize stagnant areas; such elements are optimal for applications requiring a sanitary design.

Element Performance

The performance of all FILMTEC™ elements is stated on their respective product information data sheets. An overview about the available sizes and their flow performance range is shown in Table 1.

Table 1: FILMTEC™ element types

Element type	Diameter (inch)	Permeate flow[1] at standard test conditions (GPD)	(L/h)	Maximum operating pressure (bar)	(psi)
NF270	2.5, 4, 8	850 – 14,700	134 – 2,300	41	600
NF200	2.5, 4, 8	460 – 8,000	73 – 1,260	41	600
NF90	2.5, 4, 8	525 – 10,300	83 – 1,620	41	600
TW30	1.8	24 – 100	3.8 – 16	21	300
TW30, TW30HP	2, 2.5, 4	100 – 3,200	16 – 500	41	600
BW30	2.5, 4, 8	750 – 10,500	120 – 1,660	41	600
BW30LE	4, 8	2,000 – 11,500	320 – 1,830	41	600
XLE	2.5, 4, 8	330 – 13,000	52 – 2,040	41	600
SW30	2.5, 4	150 – 1,950	24 – 300	69	1,000
SW30HR	8	6,000	950	84	1,200
SW30HRLE	8	7,500	1,200	84	1,200
SW30XLE	8	9,000	1,400	69	1,200

[1] Varying with different element dimensions and test conditions.

Le condizioni standard di test delle membrane variano a seconda del tipo di membrana. Di seguito si riassumono le condizioni di test utilizzate per stabilire le prestazioni delle membrane FILMTEC ™.

The standard element test conditions vary depending on the membrane type. summarizes the test conditions used to specify the performance of FILMTEC™ elements.

Table 2: Standard test conditions for FILMTEC™ elements

Element type	Feedwater	Temperature	Pressure psi	bar	pH	Recovery	Test time
NF200 NF270 NF90	$MgSO_4$, 2,000 ppm	77°F (25°C)	70	4.8	8	15%	20 min.
NF200 NF270	$CaCl_2$, 500 ppm	77°F (25°C)	70	4.8	8	15%	20 min.
NF90	NaCl, 2,000 ppm	77°F (25°C)	70	4.8	8	15%	20 min.
LPTW	Tap water, 250 ppm	77°F (25°C)	50	3.45	8	15%	20 min.
BW30LE	NaCl, 2,000 ppm	77°F (25°C)	150	10.3	8	15%	20 min.
XLE	NaCl, 500 ppm	77°F (25°C)	100	6.9	8	15%	20 min.
TW30 BW30	NaCl, 2,000 ppm	77°F (25°C)	225	15.5	8	15%	20 min.
SW30	NaCl, 32,000 ppm	77°F (25°C)	800	55	8	10%[†]	20 min.
SW30HR	NaCl, 32,000 ppm	77°F (25°C)	800	55	8	8%	20 min.

[†] 8% for 2.5-inch and 4-inch diameter elements.

TapTec™ TT-1812-50

TT-1812-50 GPD

I moduli ad osmosi inversa residenziale TapTec ™ forniscono un ottimo compromesso tra affidabilità e prestazioni sfruttando le comprovate tecnologie produttive DuPont - uno dei marchi più affidabili nel trattamento delle acque e inventore del film sottile per membrana osmotica, il fulcro della tecnologia RO. Concepite tenedo conto dei protocolli operativi di purificazione e studiate per trattare acque potabili, le membrane RO TapTec ™ si prefiggono a diventare la scelta naturale per tutte le famiglie. Per ulteriori informazioni, potete visionare il sito web http://www.dupont.com/water.html o chiedere consiglio ad Hytek S.r.l. che saprà consigliarvi sia sulla migliore scelta per le vostre esigenze che sulle condizioni operative.

TT-1812-50 GPD

TapTec™ Residential Reverse Osmosis (RO) Elements provide a unique balance of reliability and value for performance through leveraging the proven technologies from DuPont - one of the most trusted brands in water treatment and the inventor of thin-film composite RO membrane, the core of modern RO technology. Focused on the local water conditions and water purifier operations, TapTec™ RO Elements are committed to be the choice for normal households.
For further information on product selection, please visit http://www.dupont.com/water.html or seek advice from your DuPont representative in order to determine the best membrane choice and optimum operating conditions.

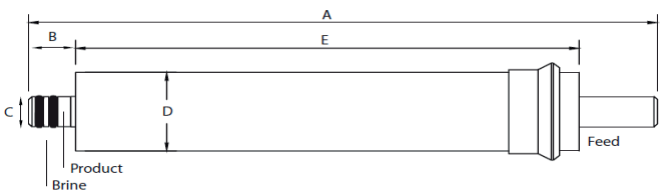
Modulo a spirale con membrana composita in sottile poliammide / *Spiral-wound element with polyamide thin-film composite membrane*

Caratteristiche tipiche / *Typical properties*

FilmTec™ Element	Applied Pressure (psig)	Applied Pressure (bar)	Permeate Flow Rate (GPD)	Permeate Flow Rate (l/h)	Typical Stabilized Salt Rejection (%)
TT-1812-50	60	4.1	50	7.9	98

1. Flusso del permeato e reiezione salina ottenuti alle seguenti condizioni di test: 250 ppm NaCl, 77°F (25°C), *pH 8.0*, 15% di recupero alla pressione specificata./ *Permeate flow and salt rejection based on the following test conditions: 250 ppm NaCl, 77°F (25°C), pH 8.0, 15% recovery and the specified applied pressure.*
2. Reiezione salina minima del 96.0%./ *Minimum salt rejection is 96.0%.*
3. Il flusso minimo di permeato per ciascun modulo è di 50 GPD/ *Minimum permeate flow for individual elements is 50 GPD.*

Dimensioni/*Dimensions*



FilmTec™ Element	A (inc)	A (mm.)	B (in.)	B (mm)	C (in.)	C (mm)	D (in.)	D (mm)	E (in.)	E (mm)
TT-1812-50	11.74	298	0.875	22.2	0.68	17	1.75	44.5	9.4	239

TT-1812 Guarnizione per moduli con diametro interno standard da 2,0 pollici - 2,05 pollici all'interno vessels.
TT-1812 Residential Elements seal at a standard 2.0 inch – 2.05 inch I.D. within pressure vessels

Figure 1: Impatto della pressione sul flusso del permeaato (recupero e temperatura

Figure 2: Impatto della temperaura sul flusso del permeaato (recupero e pressione

Figure 1: Impatto della pressione sul flusso del permeaato (recupero e temperatura costanti)/*Figure 1: Impact of Pressure on Permeate Flow (constant temperature, recovery)*

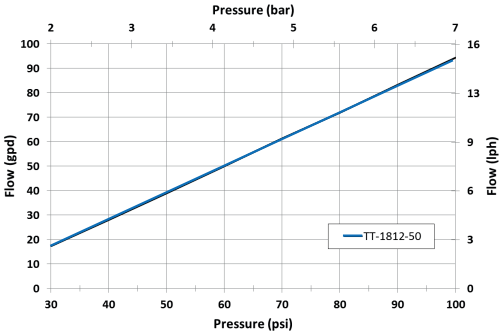
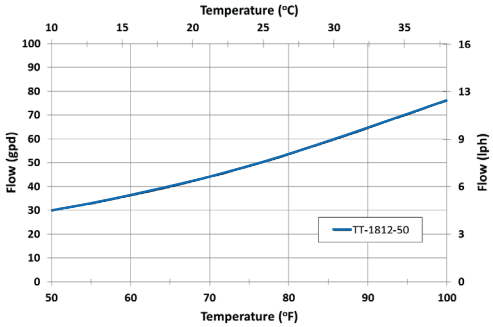


Figure 2: Impatto della temperaura sul flusso del permeaato (recupero e pressione costanti)/*Figure 1: Impact of Temperature on Permeate Flow (constant Pressure, recovery)*



Limiti operativi e di lavaggio/*Operating and Cleaning Limits*

Temperatura massima di esercizio[a]/*Maximum Operating Temperature*[a]	113°F (45°C)
Pressione massima di esercizio/*Maximum Operating Pressure*	150 psig (10 bar)
Portata massima in alimento/*Maximum Feed Flow Rate*	2.0 gpm (7.6 lpm)
Limiti di pH, in continuo[a]/*pH Range, Continuous Operation*[a]	4 – 11
Valore Massimo di Sporcamento (indice SDI)/*Maximum Feed Silt Density Index (SDI)*	SDI 5
Tolleranza massima al Cloro libero[b]/*Free Chlorine Tolerance*[b]	< 0.1 ppm

a. La temperatura massima per un funzionamento in continuo a pH superiore a 10 è di 35 ° C (95 ° F)./*Maximum temperature for continuous operation above pH 10 is 95°F (35°C).*

b. In determinate condizioni, la presenza di cloro libero e altri agenti ossidanti causerà la rottura prematura della membrana. Poiché i danni da ossidazione non sono coperti da garanzia, DuPont Water Solutions raccomanda di rimuovere il cloro libero mediante pretrattamento. Per ulteriori informazioni, la preghiamo di visionare il documento online "Declorazione dell' acqua di alimentazione" (n. 45-D01569-it) all' indirizzo www.dupont.com./*Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.*

Ulteriori e importanti informazioni

● E' raccomandato flussare le membrane per 24 ore prima del loro utilizzo in modo da poter rispettare gli standard imposti dal NSF / ANSI 58.

● Per facilitare l'installazione, si consiglia di utilizzare un lubrificante sicuro per contatto indiretto dell' acqua su tutte le tenute. Le possibili soluzioni sono: acqua, lubrificanti a base di glicerina e MOLYKOTE® 111.

● Ruotare il modulo di circa un quarto di giro per facilitarne sia l' inserimento che la rimozione. Garantire una buona tenuta tra gli o-ring e la guarnizione del concentrato.

● Mantenere sempre i moduli umidi dopo la prima bagnatura.

● Per prevenire la proliferazione biologica durante i fermi prolungati del sistema, si consiglia di immergere i moduli in una soluzione conservante. Risciacquare dal conservante prima dell'uso.

● A breve termine, la membrana mostra una certa resistenza al cloro (ipoclorito). Tuttavia l'esposizione continua deve essere evitata poichè può danneggiare la membrana.

● I moduli osmotici e di nanofiltrazione FilmTec ™ per acqua potabile, possono essere coperti da una garanzia limitata di tre anni Pro rata (modulo n. 45-D00903-it) estensa anche agli OEM. Tale garanzia tuttavia non è trasferibile. Contattare un rappresentante DuPont per ulteriori informazioni. Se i limiti operativi e le linee guida fornite nel presente Bollettino informativo non vengono seguiti rigorosamente, la Garanzia limitata sarà nulla. L'OEM è pienamente responsabile degli effetti causati da eventuali sostanze chimiche e lubrificanti incompatibili con i moduli. L'uso di tali prodotti chimici o lubrificanti annullerà la garanzia limitata.

Nota normativa

In alcuni paesi, questo prodotto potrebbe essere soggetto a restrizioni su applicazioni potabili; si prega di eseguire tutte le dovute verifiche prima della sua vendita e/o utilizzo.

Additional Important Information

● It is recommended that systems using these elements rinse the elements for 24 hours, prior to first use, to meet NSF/ANSI 58 Standard.

● To ease installation, it is recommended to use a lubricant safe for indirect water contact on all seals. Potential options include water, glycerin based lubricants, and MOLYKOTE® 111 Compound.

● Rotate the element about a quarter turn to ease installation and removal of the element. Ensure good interface between the o-rings and brine seal with their connection surfaces.

● Keep elements moist at all times after initial wetting.

● To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution. Rinse out the preservative before use.

● The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.

● FilmTec™ Home Drinking Water Reverse Osmosis Elements may be covered under the FilmTec™ Reverse Osmosis and Nanofiltration Three-Year Prorated Limited Warranty (Form No. 45-D00903-en) extended to OEMs. Such Limited Warranty is non- transferable. Contact a DuPont representative for more information. If operating limits and guidelines given in this Product Information Bulletin are not strictly followed, the Limited Warranty will be null and void. The OEM is fully responsible for the effects of incompatible chemicals and lubricants on elements. Use of any such chemicals or lubricants will void the Limited Warranty.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

TapTec™ TT-1812-75

TT-1812-75 GPD

I moduli ad osmosi inversa residenziale TapTec ™ forniscono un ottimo compromesso tra affidabilità e prestazioni sfruttando le comprovate tecnologie produttive DuPont - uno dei marchi più affidabili nel trattamento delle acque e inventore del film sottile per membrana osmotica, il fulcro della tecnologia RO. Concepite tenedo conto dei protocolli operativi di purificazione e studiate per trattare acque potabili, le membrane RO TapTec ™ si prefiggono a diventare la scelta naturale per tutte le famiglie. Per ulteriori informazioni, potete visionare il sito web http://www.dupont.com/water.html o chiedere consiglio ad Hytek S.r.l. che saprà consigliarvi sia sulla migliore scelta per le vostre esigenze che sulle condizioni operative.

TT-1812-75 GPD

TapTec™ Residential Reverse Osmosis (RO) Elements provide a unique balance of reliability and value for performance through leveraging the proven technologies from DuPont - one of the most trusted brands in water treatment and the inventor of thin-film composite RO membrane, the core of modern RO technology. Focused on the local water conditions and water purifier operations, TapTec™ RO Elements are committed to be the choice for normal households.
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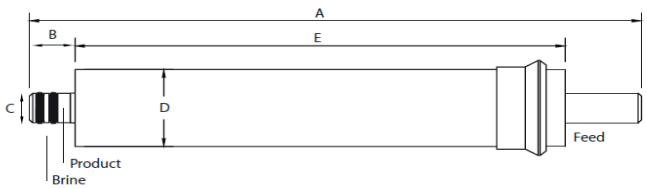
Modulo a spirale con membrana composita in sottile poliammide / ***Spiral-wound element with polyamide thin-film composite membrane***

Caratteristiche tipiche / ***Typical properties***

FilmTec™ Element	Applied Pressure (psig)	Applied Pressure (bar)	Permeate Flow Rate (GPD)	Permeate Flow Rate (l/h)	Typical Stabilized Salt Rejection (%)
TT-1812-75	50	3.4	75	12	97

1. Flusso del permeato e reiezione salina ottenuti alle seguenti condizioni di test: 250 ppm NaCl, 77°F (25°C), *pH 8.0*, 15% di recupero alla pressione specificata./ *Permeate flow and salt rejection based on the following test conditions: 250 ppm NaCl, 77°F (25°C), pH 8.0, 15% recovery and the specified applied pressure.*
2. Reiezione salina minima del 95.0%./ *Minimum salt rejection is 96.0%.*
3. Il flusso minimo di permeato per ciascun modulo può variare del *+30/-20%. / Permeate flows for individual elements may vary +30/-20%.*

Dimensioni/*Dimensions*



FilmTec™ Element	A (inc)	A (mm.)	B (in.)	B (mm)	C (in.)	C (mm)	D (in.)	D (mm)	E (in.)	E (mm)
TT-1812-75	11.74	298	0.875	22.2	0.68	17	1.75	44.5	9.4	239

TT-1812 Guarnizione per moduli con diametro interno standard da 2,0 pollici - 2,05 pollici all'interno vessels.
TT-1812 Residential Elements seal at a standard 2.0 inch – 2.05 inch I.D. within pressure vessels

Figure 1: Impatto della pressione sul flusso del permeaato (recupero e temperatura costanti)/*Figure 1: Impact of Pressure on Permeate Flow (constant temperature, recovery)*

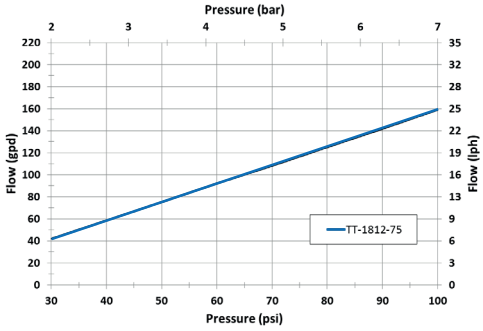
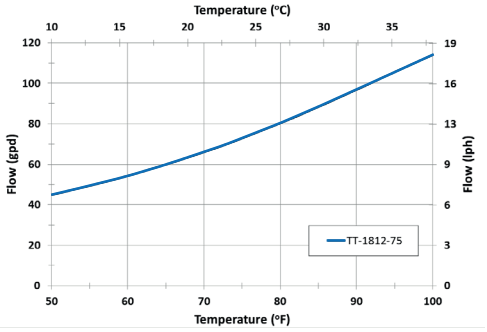


Figure 2: Impatto della temperaura sul flusso del permeaato (recupero e pressione costanti)/*Figure 1: Impact of Temperature on Permeate Flow (constant Pressure, recovery)*



Limiti operativi e di lavaggio/*Operating and Cleaning Limits*

Temperatura massima di esercizio[a]/*Maximum Operating Temperature*[a]	113°F (45°C)
Pressione massima di esercizio/*Maximum Operating Pressure*	150 psig (10 bar)
Portata massima in alimento/*Maximum Feed Flow Rate*	2.0 gpm (7.6 lpm)
Limiti di pH, in continuo[a]/*pH Range, Continuous Operation*[a]	2 –11
Valore Massimo di Sporcamento (indice SDI)/*Maximum Feed Silt Density Index (SDI)*	SDI 5
Tolleranza massima al Cloro libero[b]/*Free Chlorine Tolerance*[b]	< 0.1 ppm

a. La temperatura massima per un funzionamento in continuo a pH superiore a 10 è di 35 ° C (95 ° F)./*Maximum temperature for continuous operation above pH 10 is 95°F (35°C).*

b. In determinate condizioni, la presenza di cloro libero e altri agenti ossidanti causerà la rottura prematura della membrana. Poiché i danni da ossidazione non sono coperti da garanzia, DuPont Water Solutions raccomanda di rimuovere il cloro libero mediante pretrattamento. Per ulteriori informazioni, la preghiamo di visionare il documento online "Declorazione dell' acqua di alimentazione" (n. 45-D01569-it) all' indirizzo www.dupont.com./*Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.*

Ulteriori e importanti informazioni

● E' raccomandato flussare le membrane per 24 ore prima del loro utilizzo in modo da poter rispettare gli standard imposti dal NSF / ANSI 58.

● Per facilitare l'installazione, si consiglia di utilizzare un lubrificante sicuro per contatto indiretto dell' acqua su tutte le tenute. Le possibili soluzioni sono: acqua, lubrificanti a base di glicerina e MOLYKOTE® 111.

● Ruotare il modulo di circa un quarto di giro per facilitarne sia l' inserimento che la rimozione. Garantire una buona tenuta tra gli o-ring e la guarnizione del concentrato.

● Mantenere sempre i moduli umidi dopo la prima bagnatura.

● Per prevenire la proliferazione biologica durante i fermi prolungati del sistema, si consiglia di immergere i moduli in una soluzione conservante. Risciacquare dal conservante prima dell'uso.

● A breve termine, la membrana mostra una certa resistenza al cloro (ipoclorito). Tuttavia l'esposizione continua deve essere evitata poichè può danneggiare la membrana.

● I moduli osmotici e di nanofiltrazione FilmTec ™ per acqua potabile, possono essere coperti da una garanzia limitata di tre anni Pro rata (modulo n. 45-D00903-it) estensa anche agli OEM. Tale garanzia tuttavia non è trasferibile. Contattare un rappresentante DuPont per ulteriori informazioni. Se i limiti operativi e le linee guida fornite nel presente Bollettino informativo non vengono seguiti rigorosamente, la Garanzia limitata sarà nulla. L'OEM è pienamente responsabile degli effetti causati da eventuali sostanze chimiche e lubrificanti incompatibili con i moduli. L'uso di tali prodotti chimici o lubrificanti annullerà la garanzia limitata.

Nota normativa

In alcuni paesi, questo prodotto potrebbe essere soggetto a restrizioni su applicazioni potabili; si prega di eseguire tutte le dovute verifiche prima della sua vendita e/o utilizzo.

Additional Important Information

● It is recommended that systems using these elements rinse the elements for 24 hours, prior to first use, to meet NSF/ANSI 58 Standard.

● To ease installation, it is recommended to use a lubricant safe for indirect water contact on all seals. Potential options include water, glycerin based lubricants, and MOLYKOTE® 111 Compound.

● Rotate the element about a quarter turn to ease installation and removal of the element. Ensure good interface between the o-rings and brine seal with their connection surfaces.

● Keep elements moist at all times after initial wetting.

● To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution. Rinse out the preservative before use.

● The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.

● FilmTec™ Home Drinking Water Reverse Osmosis Elements may be covered under the FilmTec™ Reverse Osmosis and Nanofiltration Three-Year Prorated Limited Warranty (Form No. 45-D00903-en) extended to OEMs. Such Limited Warranty is non- transferable. Contact a DuPont representative for more information. If operating limits and guidelines given in this Product Information Bulletin are not strictly followed, the Limited Warranty will be null and void. The OEM is fully responsible for the effects of incompatible chemicals and lubricants on elements. Use of any such chemicals or lubricants will void the Limited Warranty.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW60-1812-75

BW60-1812-75 GPD

Le membrane FilmTec ™ residenziali, sono tra i prodotti più affidabili, performanti e di alto standard qualitativo presenti nel settore. Le membrane da 75 GPD, offrono il miglior equilibrio di flusso e la piu' alta reiezione ad oggi disponibile sul mercato.
Caratteristiche delle nuove membrane FilmTec ™ residenziali:
- La nuova formulazione chimica della BW60 produce una reiezione stabilizzata del 99% che ne fa la leader del settore.
- La durabilità è stata migliorata anche a durezze elevate.
- Reiezione stabilizzata in beve tepo
- Maggior area filtrante con design a doppio foglio per l' ottimizzazione delle prestazioni
- Certificazione NSF58 e costi / risorse di certificazione ridotti con trasferimento dati direttamente all' NSF
- Conforme a DM 174 del 6 aprile 2004 (normtiva italiana)
- Produzione completamente automatizzata che garantisce alta qualità e standard produttivi costanti nel tempo
- Imballo sotto vuoto per una migliorata durabilità.
- Affidabilità comprovata per una maggiore durata

BW60-1812-75 GPD

FilmTec™ Residential Elements are some of the most reliable, consistent and highest quality in the industry just got even better. Our 75 GPD elements offer the best balance of flow and highest rejection available in the market.
New FilmTec™ Residential Elements feature:
- New membrane (BW60) chemistry produces industry leading 99% stabilized salt rejection.
- Even longer lifetimes on high hardness water applications
- Even faster start-up to reach stabilized rejection
- High active membrane area and twin leaf design for optimized performance
- NSF58 safety Certification and reduced certification costs / resources with NSF data transfer Certification
- Compliant to DM 174 dd the 6th April, 2004 (Italian law)
- Fully-automated manufacturing that ensures consistent and high quality elements
- Dry shipping for convenient handling and longer shelf-life
- Proven consistency and reliability for longer membrane life

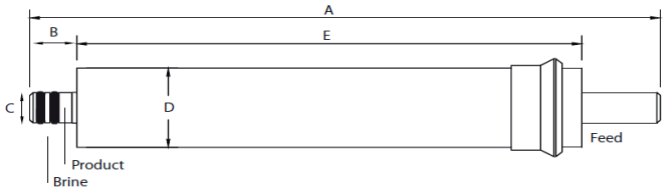
Modulo a spirale con membrana composita in sottile poliammide / ***Spiral-wound element with polyamide thin-film composite membrane***

Caratteristiche tipiche / ***Typical properties***

FilmTec™ Element	Applied Pressure (psig)	Applied Pressure (bar)	Permeate Flow Rate (GPD)	Permeate Flow Rate (l/h)	Typical Stabilized Salt Rejection (%)
BW60-1812-75	50	3.4	75	12	99

1. Flusso del permeato e reiezione salina ottenuti alle seguenti condizioni di test: acqua potabile addolcita a 250 ppm, 77°F (25°C), 15% di recupero alla pressione specificata./*Permeate flow and salt rejection based on the following test conditions: 250 ppm softened tap water, 77°F (25°C), 15% recovery and the specified applied pressure.*
2. Reiezione salina minima del 96.0%./ *Minimum salt rejection is 96.0%.*
3. I flussi sul permeato possono variare fr ciacuna membrana del ±20%./ *Permeate flows for individual elements may vary ±20%.*

Dimensioni/*Dimensions*



NSF COMPONENT

This component is Tested and Certified by NSF International against NSF/ANSI Standard 58 for material requirements only.

FilmTec™ Element	A (inc)	A (mm.)	B (in.)	B (mm)	C (in.)	C (mm)	D (in.)	D (mm)	E (in.)	E (mm)
BW60-1812-75	11.74	298	0.875	22.2	0.68	17	1.75	44.5	9.4	239

BW60-1812 Guarnizione per moduli su acqua potabile di acquedotto con diametro interno standard da 2,0 pollici - 2,05 pollici all'interno vessels.
BW60-1812 Home Drinking Water elements seal at a standard 2.0 inch – 2.05 inch I.D. within pressure vessels

Figure 1: Impatto della pressione sul flusso del permeaato (recupero e temperatura costanti)/*Figure 1: Impact of Pressure on Permeate Flow (constant temperature, recovery)*

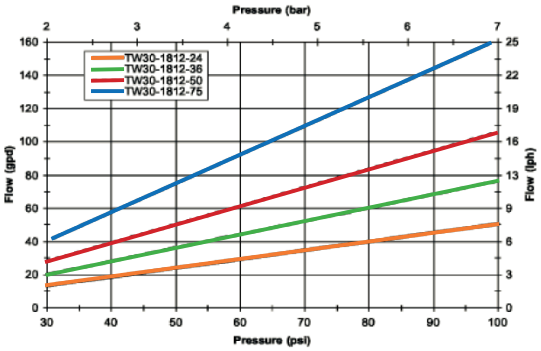
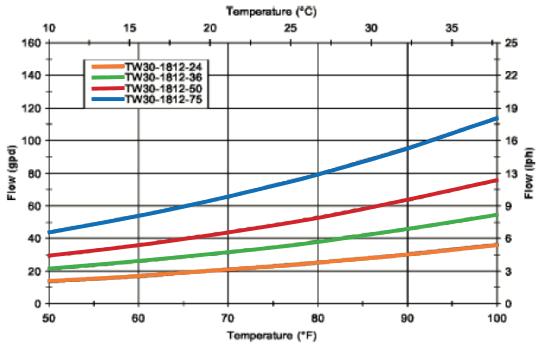


Figure 2: Impatto della temperaura sul flusso del permeaato (recupero e pressione costanti)/*Figure 1: Impact of Temperature on Permeate Flow (constant Pressure, recovery)*



Limiti operativi e di lavaggio/*Operating and Cleaning Limits*

Temperatura massima di esercizio[a]/*Maximum Operating Temperature*[a]	113°F (45°C)
Pressione massima di esercizio/*Maximum Operating Pressure*	150 psig (10 bar)
Portata massima in alimento/*Maximum Feed Flow Rate*	2.0 gpm (7.6 lpm)
Limiti di pH, in continuo[a]/*pH Range, Continuous Operation*[a]	2 – 11
Valore Massimo di Sporcamento (indice SDI)/*Maximum Feed Silt Density Index (SDI)*	SDI 5
Tolleranza massima al Cloro libero[b]/*Free Chlorine Tolerance*[b]	< 0.1 ppm

a. La temperatura massima per un funzionamento in continuo a pH superiore a 10 è di 35 ° C (95 ° F)./*Maximum temperature for continuous operation above pH 10 is 95°F (35°C).*

b. In determinate condizioni, la presenza di cloro libero e altri agenti ossidanti causerà la rottura prematura della membrana. Poiché i danni da ossidazione non sono coperti da garanzia, DuPont Water Solutions raccomanda di rimuovere il cloro libero mediante pretrattamento. Per ulteriori informazioni, la preghiamo di visionare il documento online "Declorazione dell' acqua di alimentazione" (n. 45-D01569-it) all' indirizzo www.dupont.com./*Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.*

Ulteriori e importanti informazioni

• E' raccomandato flussare le membrane per 24 ore prima del loro utilizzo in modo da poter rispettare gli standard imposti dal NSF / ANSI 58.

• Per facilitare l'installazione, si consiglia di utilizzare un lubrificante sicuro per contatto indiretto dell' acqua su tutte le tenute. Le possibili soluzioni sono: acqua, lubrificanti a base di glicerina e MOLYKOTE® 111.

• Ruotare il modulo di circa un quarto di giro per facilitarne sia l' inserimento che la rimozione. Garantire una buona tenuta tra gli o-ring e la guarnizione del concentrato.

• Mantenere sempre i moduli umidi dopo la prima bagnatura.

• Per prevenire la proliferazione biologica durante i fermi prolungati del sistema, si consiglia di immergere i moduli in una soluzione conservante. Risciacquare dal conservante prima dell'uso.

• A breve termine, la membrana mostra una certa resistenza al cloro (ipoclorito). Tuttavia l'esposizione continua deve essere evitata poichè può danneggiare la membrana.

• I moduli osmotici e di nanofiltrazione FilmTec ™ per acqua potabile, possono essere coperti da una garanzia limitata di tre anni Pro rata (modulo n. 45-D00903-it) estensa anche agli OEM. Tale garanzia tuttavia non è trasferibile. Contattare un rappresentante DuPont per ulteriori informazioni. Se i limiti operativi e le linee guida fornite nel presente Bollettino informativo non vengono seguiti rigorosamente, la Garanzia limitata sarà nulla. L'OEM è pienamente responsabile degli effetti causati da eventuali sostanze chimiche e lubrificanti incompatibili con i moduli. L'uso di tali prodotti chimici o lubrificanti annullerà la garanzia limitata.

Nota normativa

In alcuni paesi, questo prodotto potrebbe essere soggetto a restrizioni su applicazioni potabili; si prega di eseguire tutte le dovute verifiche prima della sua vendita e/o utilizzo.

Additional Important Information

• It is recommended that systems using these elements rinse the elements for 24 hours, prior to first use, to meet NSF/ANSI 58 Standard.

• To ease installation, it is recommended to use a lubricant safe for indirect water contact on all seals. Potential options include water, glycerin based lubricants, and MOLYKOTE® 111 Compound.

• Rotate the element about a quarter turn to ease installation and removal of the element. Ensure good interface between the o-rings and brine seal with their connection surfaces.

• Keep elements moist at all times after initial wetting.

• To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution. Rinse out the preservative before use.

• The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.

• FilmTec™ Home Drinking Water Reverse Osmosis Elements may be covered under the FilmTec™ Reverse Osmosis and Nanofiltration Three-Year Prorated Limited Warranty (Form No. 45-D00903-en) extended to OEMs. Such Limited Warranty is non- transferable. Contact a DuPont representative for more information. If operating limits and guidelines given in this Product Information Bulletin are not strictly followed, the Limited Warranty will be null and void. The OEM is fully responsible for the effects of incompatible chemicals and lubricants on elements. Use of any such chemicals or lubricants will void the Limited Warranty.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ TW30-1812-100

TW30-1812-100 GPD

Le membrane osmosi inversa (RO) FILMTEC sono membrane per aplicazioni domestiche e rappresentano un prodotto di altissima qualità e affidabilità. La tecnologia utilizzata per l' avvolgimento della membrana unito ad un altissimo ed avanzato standard produttivo, hanno permesso alle membrane TW30 1812, di raggiungere prestazioni superiori alla concorrenza

(anche più del 20%), rendendole uniche per i rivenditori e gli installatori. Le membrane TW30 1812 vengono conservate in forma Dry (spedite sotto vuoto per evitare proliferazioni batteriche e assicurare una maggior durata per prolungati stoccaggi). Le TW1812 sono certificate NSF/ANSI 58.

TW30-1812-100 GPD

FILMTEC reverse osmosis (RO) membrane elements for home drinking water are the industry's most reliable. Advanced membrane technology and automated fabrication allow these elements to deliver consistent performance that equipment suppliers, water treatment dealers and residential customers can rely on. FILMTEC elements are shipped dry for convenient handling and long shelf-life. These elements are NSF/ANSI Standard 58 listed. FILMTEC home drinking water elements are rated a 50 psi and will purify about 20% more water than competitive elements rated at 60 psi (please see reference charts for more information).

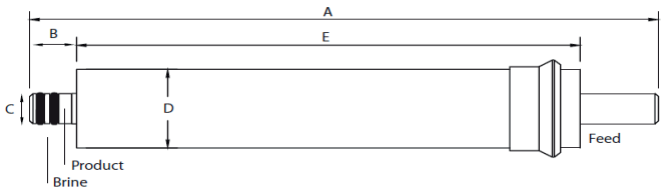
Modulo a spirale con membrana composita in sottile poliammide / *Spiral-wound element with polyamide thin-film composite membrane*

Caratteristiche tipiche / *Typical properties*

FilmTec™ Element	Applied Pressure (psig)	Applied Pressure (bar)	Permeate Flow Rate (GPD)	Permeate Flow Rate (l/h)	Typical Stabilized Salt Rejection (%)
TW30-1812-100	50	3.4	100	16	90

1. La produzione del permeato e la reiezione sono riferiti alle seguenti condizioni di test: 250 ppm acqua addolcita, 77°F (25°C), 15% di recupero con pressione applicata e specificata / *Permeate flow and salt rejection based on the following test conditions: 250 ppm softened tap water, 77°F (25°C), 15% recovery and the specified applied pressure.*
2. Reiezione salina minimadel 90.0% / *Minimum salt rejection is 90.0%.*
3. Il flusso minimo di permeato per ciascun modulo può variare del +/-20%. / *Permeate flows for individual elements may vary +/-20%.*
4. Le specifiche del prodotto possono variare leggermente man mano che si raggiunge il regime. / *Product specifications may vary slightly as improvements are implemented.*
5. Per facilitare l'installazione, gli o-ring dei moduli sono stati pre-lubrificati con glicerina. / *For ease of installation, element o-rings have been pre-lubricated with glycerin. .*

Dimensioni/*Dimensions*



FilmTec™ Element	A (inc)	A (mm.)	B (in.)	B (mm)	C (in.)	C (mm)	D (in.)	D (mm)	E (in.)	E (mm)
TW30-1812-100	11.74	298	0.875	22.2	0.68	17	1.75	44.5	9.4	239

TW30-1812-100 Guarnizione per moduli con diametro interno standard da 2,0 pollici - 2,05 pollici all'interno vessels.
TW30-1812-100 *Residential Elements seal at a standard 2.0 inch – 2.05 inch I.D. within pressure vessels*

Figure 1: Impatto della pressione sul flusso del permeaato (recupero e temperatura costanti)/*Figure 1: Impact of Pressure on Permeate Flow (constant temperature, recovery)*

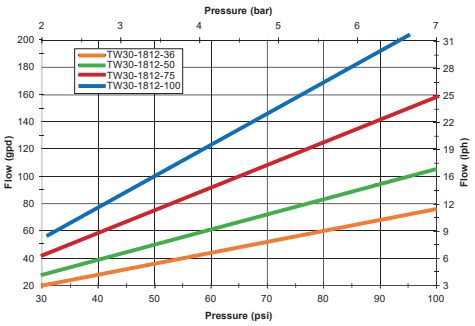
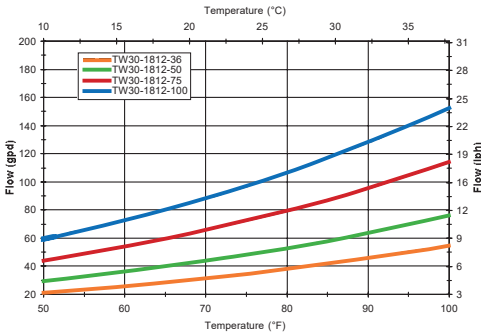


Figure 2: Impatto della temperaura sul flusso del permeaato (recupero e pressione costanti)/*Figure 1: Impact of Temperature on Permeate Flow (constant Pressure, recovery)*



Limiti operativi e di lavaggio/*Operating and Cleaning Limits*

Temperatura massima di esercizio[a]/*Maximum Operating Temperature*[a]	113°F (45°C)
Pressione massima di esercizio/*Maximum Operating Pressure*	300 psig (21 bar)
Portata massima in alimento/*Maximum Feed Flow Rate*	2.0 gpm (7.6 lpm)
Limiti di pH, in continuo[a]/*pH Range, Continuous Operation*[a]	2 –11
Valore Massimo di Sporcamento (indice SDI)/*Maximum Feed Silt Density Index (SDI)*	SDI 5
Tolleranza massima al Cloro libero[b]/*Free Chlorine Tolerance*[b]	< 0.1 ppm

a. La temperatura massima per un funzionamento in continuo a pH superiore a 10 è di 35 ° C (95 ° F)./*Maximum temperature for continuous operation above pH 10 is 95°F (35°C).*

b. In determinate condizioni, la presenza di cloro libero e altri agenti ossidanti causerà la rottura prematura della membrana. Poiché i danni da ossidazione non sono coperti da garanzia, DuPont Water Solutions raccomanda di rimuovere il cloro libero mediante pretrattamento. Per ulteriori informazioni, la preghiamo di visionare il documento online "Declorazione dell' acqua di alimentazione" (n. 45-D01569-it) all' indirizzo www.dupont.com./*Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.*

Ulteriori e importanti informazioni

• E' raccomandato flussare le membrane per 24 ore prima del loro utilizzo in modo da poter rispettare gli standard imposti dal NSF / ANSI 58.

• Per facilitare l'installazione, si consiglia di utilizzare un lubrificante sicuro per contatto indiretto dell' acqua su tutte le tenute. Le possibili soluzioni sono: acqua, lubrificanti a base di glicerina e MOLYKOTE® 111.

• Ruotare il modulo di circa un quarto di giro per facilitarne sia l' inserimento che la rimozione. Garantire una buona tenuta tra gli o-ring e la guarnizione del concentrato.

• Mantenere sempre i moduli umidi dopo la prima bagnatura.

• Per prevenire la proliferazione biologica durante i fermi prolungati del sistema, si consiglia di immergere i moduli in una soluzione conservante. Risciacquare dal conservante prima dell'uso.

• A breve termine, la membrana mostra una certa resistenza al cloro (ipoclorito). Tuttavia l'esposizione continua deve essere evitata poichè può danneggiare la membrana.

• I moduli osmotici e di nanofiltrazione FilmTec ™ per acqua potabile, possono essere coperti da una garanzia limitata di tre anni Pro rata (modulo n. 45-D00903-it) estensa anche agli OEM. Tale garanzia tuttavia non è trasferibile. Contattare un rappresentante DuPont per ulteriori informazioni. Se i limiti operativi e le linee guida fornite nel presente Bollettino informativo non vengono seguiti rigorosamente, la Garanzia limitata sarà nulla. L'OEM è pienamente responsabile degli effetti causati da eventuali sostanze chimiche e lubrificanti incompatibili con i moduli. L'uso di tali prodotti chimici o lubrificanti annullerà la garanzia limitata.

Nota normativa

In alcuni paesi, questo prodotto potrebbe essere soggetto a restrizioni su applicazioni potabili; si prega di eseguire tutte le dovute verifiche prima della sua vendita e/o utilizzo.

Additional Important Information

• It is recommended that systems using these elements rinse the elements for 24 hours, prior to first use, to meet NSF/ANSI 58 Standard.

• To ease installation, it is recommended to use a lubricant safe for indirect water contact on all seals. Potential options include water, glycerin based lubricants, and MOLYKOTE® 111 Compound.

• Rotate the element about a quarter turn to ease installation and removal of the element. Ensure good interface between the o-rings and brine seal with their connection surfaces.

• Keep elements moist at all times after initial wetting.

• To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution. Rinse out the preservative before use.

• The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.

• FilmTec™ Home Drinking Water Reverse Osmosis Elements may be covered under the FilmTec™ Reverse Osmosis and Nanofiltration Three-Year Prorated Limited Warranty (Form No. 45-D00903-en) extended to OEMs. Such Limited Warranty is non- transferable. Contact a DuPont representative for more information. If operating limits and guidelines given in this Product Information Bulletin are not strictly followed, the Limited Warranty will be null and void. The OEM is fully responsible for the effects of incompatible chemicals and lubricants on elements. Use of any such chemicals or lubricants will void the Limited Warranty.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ TW30-1812-100HR

TW30-1812-100 GPD (HR)

I moduli FilmTec ™ della linea residenziale, sono tra i prodotti più affidabili, performanti e di alto standard qualitativo presenti nel settore industriale. I nostri moduli da100 GPD offrono un flusso elevato con un' altissima reiezione, ideale per applicazioni residenziali a bassa pressione. Le principali caratteristiche sono:

- Nuova formulazione chimica della membra che può arrivare ad una reiezione salina stabilizzata del 98%.
- Maggior area filtrante con design a doppio foglio per l' ottimizzazione delle prestazioni
- Certificazione NSF58 e costi / risorse di certificazione ridotti con trasferimento dati direttamente all' NSF
- Produzione completamente automatizzata che garantisce alta qualità e standard produttivi costanti nel tempo
- Imballo sotto vuoto per una migliorata durabilità.
- Affidabilità comprovata per una maggiore durata

TW30-1812-100 GPD (HR)

FilmTec™ Residential Elements are some of the most reliable, consistent and highest quality in the industry. Our 100 GPD elements offer a superior balance of the highest available flow with premium rejection, ideal for low feed pressure residential applications. FilmTec™ Residential Elements feature:

- New advanced membrane chemistry can achieve stabilized salt rejection of 98%.
- High active membrane area and twin leaf design for optimized performance
- NSF58 safety Certification and reduced certification costs / resources with NSF data transfer Certification
- Fully-automated manufacturing that ensures consistent and high quality elements
- Dry shipping for convenient handling and longer shelf-life
- Proven consistency and reliability for longer membrane life

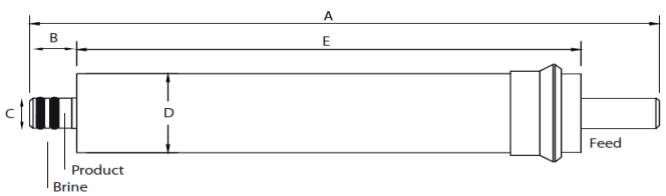
Modulo a spirale con membrana composita in sottile poliammide / *Spiral-wound element with polyamide thin-film composite membrane*

Caratteristiche tipiche / *Typical properties*

FilmTec™ Element	Permeate Flow Rate (GPD)	(l/h)	Typical Stabilized Salt Rejection (%)
TW30- 1812-100HR	100	15.8	98

1. Flusso del permeato e reiezione salina ottenuti alle seguenti condizioni di test: acqua potabile addolcita a 250 ppm, 77°F (25°C), 15% di recupero alla pressione specificata./*Permeate flow and salt rejection based on the following test conditions: 250 ppm softened tap water, 77°F (25°C), 15% recovery and the specified applied pressure.*
2. Reiezione salina minima del 96.0%./ *Minimum salt rejection is 96.0%.*
3. I flussi sul permeato possono variare fr ciacuna membrana del ±20%./ *Permeate flows for individual elements may vary ±20%.*

Dimensioni/*Dimensions*



	A		B		C		D		E	
FilmTec™ Element	(inc)	(mm.)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
TW30-1812-100HR	11.74	298	0.875	22.2	0.68	17	1.75	44.5	9.4	239

TW30-1812-100 Guarnizione per moduli con diametro interno standard da 2,0 pollici - 2,05 pollici all'interno vessels.
TW30-1812-100 *Residential Elements seal at a standard 2.0 inch – 2.05 inch I.D. within pressure vessels*

Figure 1: Impatto della pressione sul flusso del permeaato (recupero e temperatura costanti)/*Figure 1: Impact of Pressure on Permeate Flow (constant temperature, recovery)*

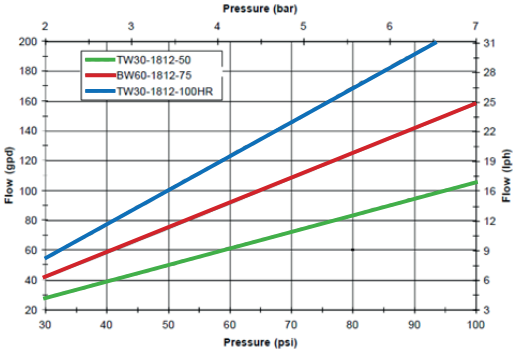
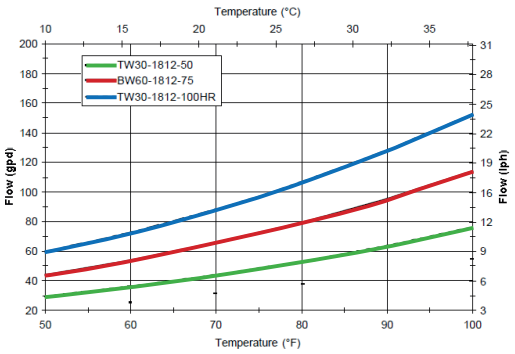


Figure 2: Impatto della temperaura sul flusso del permeaato (recupero e pressione costanti)/*Figure 1: Impact of Temperature on Permeate Flow (constant Pressure, recovery)*



Limiti operativi e di lavaggio/*Operating and Cleaning Limits*

Temperatura massima di esercizio[a]/*Maximum Operating Temperature*[a]	113°F (45°C)
Pressione massima di esercizio/*Maximum Operating Pressure*	150 psig (21 bar)
Portata massima in alimento/*Maximum Feed Flow Rate*	2.0 gpm (7.6 lpm)
Limiti di pH, in continuo[a]/*pH Range, Continuous Operation*[a]	2 –11
Valore Massimo di Sporcamento (indice SDI)/*Maximum Feed Silt Density Index (SDI)*	SDI 5
Tolleranza massima al Cloro libero[b]/*Free Chlorine Tolerance*[b]	< 0.1 ppm

a. La temperatura massima per un funzionamento in continuo a pH superiore a 10 è di 35 ° C (95 ° F)./*Maximum temperature for continuous operation above pH 10 is 95°F (35°C).*

b. In determinate condizioni, la presenza di cloro libero e altri agenti ossidanti causerà la rottura prematura della membrana. Poiché i danni da ossidazione non sono coperti da garanzia, DuPont Water Solutions raccomanda di rimuovere il cloro libero mediante pretrattamento. Per ulteriori informazioni, la preghiamo di visionare il documento online "Declorazione dell' acqua di alimentazione" (n. 45-D01569-it) all' indirizzo www.dupont.com./*Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.*

Ulteriori e importanti informazioni

● E' raccomandato flussare le membrane per 24 ore prima del loro utilizzo in modo da poter rispettare gli standard imposti dal NSF / ANSI 58.

● Per facilitare l'installazione, si consiglia di utilizzare un lubrificante sicuro per contatto indiretto dell' acqua su tutte le tenute. Le possibili soluzioni sono: acqua, lubrificanti a base di glicerina e MOLYKOTE® 111.

● Ruotare il modulo di circa un quarto di giro per facilitarne sia l' inserimento che la rimozione. Garantire una buona tenuta tra gli o-ring e la guarnizione del concentrato.

● Mantenere sempre i moduli umidi dopo la prima bagnatura.

● Per prevenire la proliferazione biologica durante i fermi prolungati del sistema, si consiglia di immergere i moduli in una soluzione conservante. Risciacquare dal conservante prima dell'uso.

● A breve termine, la membrana mostra una certa resistenza al cloro (ipoclorito). Tuttavia l'esposizione continua deve essere evitata poichè può danneggiare la membrana.

● I moduli osmotici e di nanofiltrazione FilmTec ™ per acqua potabile, possono essere coperti da una garanzia limitata di tre anni Pro rata (modulo n. 45-D00903-it) estensa anche agli OEM. Tale garanzia tuttavia non è trasferibile. Contattare un rappresentante DuPont per ulteriori informazioni. Se i limiti operativi e le linee guida fornite nel presente Bollettino informativo non vengono seguiti rigorosamente, la Garanzia limitata sarà nulla. L'OEM è pienamente responsabile degli effetti causati da eventuali sostanze chimiche e lubrificanti incompatibili con i moduli. L'uso di tali prodotti chimici o lubrificanti annullerà la garanzia limitata.

Nota normativa

In alcuni paesi, questo prodotto potrebbe essere soggetto a restrizioni su applicazioni potabili; si prega di eseguire tutte le dovute verifiche prima della sua vendita e/o utilizzo.

Additional Important Information

● It is recommended that systems using these elements rinse the elements for 24 hours, prior to first use, to meet NSF/ANSI 58 Standard.

● To ease installation, it is recommended to use a lubricant safe for indirect water contact on all seals. Potential options include water, glycerin based lubricants, and MOLYKOTE® 111 Compound.

● Rotate the element about a quarter turn to ease installation and removal of the element. Ensure good interface between the o-rings and brine seal with their connection surfaces.

● Keep elements moist at all times after initial wetting.

● To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution. Rinse out the preservative before use.

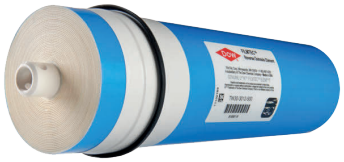
● The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.

● FilmTec™ Home Drinking Water Reverse Osmosis Elements may be covered under the FilmTec™ Reverse Osmosis and Nanofiltration Three-Year Prorated Limited Warranty (Form No. 45-D00903-en) extended to OEMs. Such Limited Warranty is non- transferable. Contact a DuPont representative for more information. If operating limits and guidelines given in this Product Information Bulletin are not strictly followed, the Limited Warranty will be null and void. The OEM is fully responsible for the effects of incompatible chemicals and lubricants on elements. Use of any such chemicals or lubricants will void the Limited Warranty.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ TW30-3012-500



TW30-3012-500 GPD

I moduli FilmTec ™ TW30-3012-500 offrono un alto flusso, un' affidabile reiezione salina e una lunga durata per tutti i sistemi in cui non è prevsto l' uso di sebatoi di accumulo. La tecnologia brevettata di FilmTec ™ che sfrutta il design della membrana e il suo particolare foglio, viene utilizzata per l' ottenimento di prestazioni che consentono una maggiore flessibilità di progettazione nei sistemi a produzione diretta. Le sue peculiarità sono:

- Flusso superiore fino al 20% a parità di pressione, rispetto ai prodotti concorrenti
- Prestazioni affidabili e costanti nel tempo anche nel trattamento di acque con durezza elevata
- La dimensione del modulo 3012 permette di occupare meno spazio e quindi di realizzare impianti compatti e salva spazio
- Certificazione internazionale NSF
- Spedizione sotto vuoto per lunghi stoccaggi e migliorata gestione

TW30-3012-500 GPD

FilmTec™ TW30-3012-500 Residential RO Elements offer high flow, reliable salt rejection, and long element life as expected for use in premium tankless purifier systems. The combination of FilmTec™ patented membrane flat sheet technology and engineered element design is harnessed to achieve performance that enables improved design flexibility for premium tankless systems. A summary of the element features includes:

- Up to 20% higher flow versus competitive elements operated at the same pressure
- Stable, reliable performance even when treating high hardness waters
- 3012 element size for space-saving, compact purifier designs
- NSF International safety certification
- Dry shipping for convenient handling and long shelf-life

Product Type

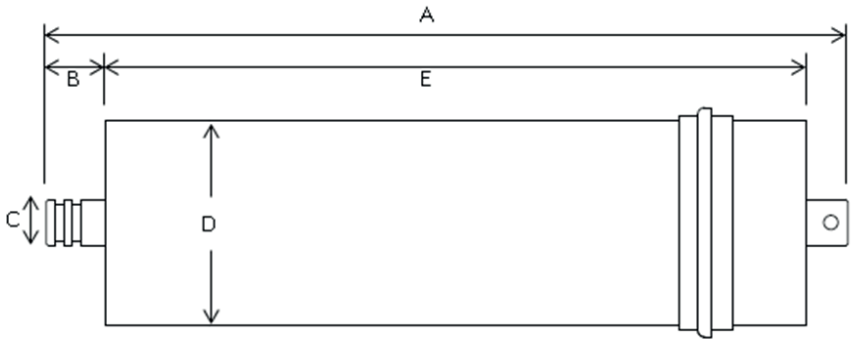
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Applied Pressure (psig)	Applied Pressure (bar)	Permeate Flow Rate (GPD)	Permeate Flow Rate (L/m)	Typical Stabilized Salt Rejection (%)
TW30-3012-500	70	4.8	500	1.3	98

1. Permeate flow and salt rejection based on the following test conditions: 250 ppm NaCl, 77°F (25°C), pH 8.0, 40% recovery and the specified applied pressure.
2. Minimum salt rejection is 96.0%.
3. Permeate flows for individual elements may vary +25/-15%

Element Dimensions



FilmTec™ Element	A (in.)	A (mm.)	B (in.)	B (mm)	C (in.)	C (mm)	D (in.)	D (mm)	E (in.)	E (mm)
TW30-3012-500	11.74	298	0.875	22.2	0.68	17	2.95	74.9	10.25	260.4

TW30-3012 Residential Elements seal at a standard 3.0 inch – 3.05 inch I.D. within pressure vessels

Figure 1: Impact of Pressure on Target Permeate Flow (constant temperature, recovery)

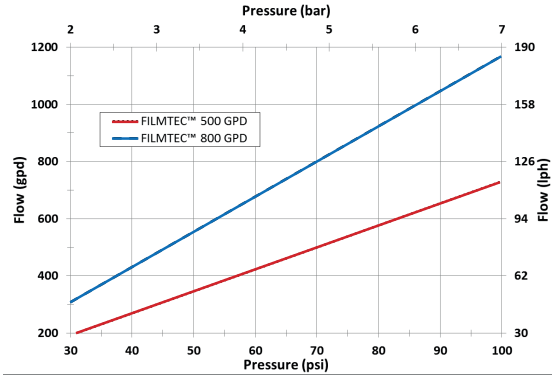
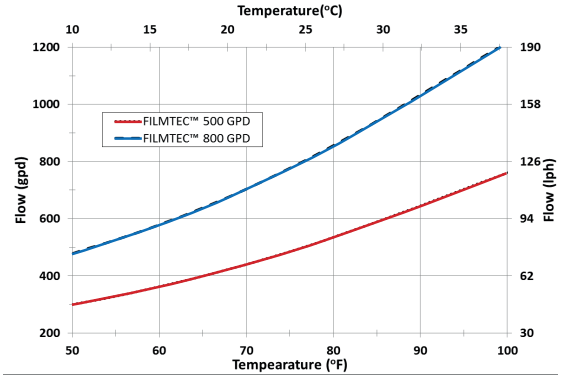


Figure 2: Impact of Temperature on Target Permeate Flow (constant pressure, recovery)



Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	150 psig (10 bar)
Maximum Feed Flow Rate	2.5 gpm (9.5 lpm)
pH Range, Continuous Operation	2 – 11
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [b]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en) for more information.

Ulteriori e importanti informazioni

• E' raccomandato flussare le membrane per 24 ore prima del loro utilizzo in modo da poter rispettare gli standard imposti dal NSF / ANSI 58.

• Per facilitare l'installazione, si consiglia di utilizzare un lubrificante sicuro per contatto indiretto dell' acqua su tutte le tenute. Le possibili soluzioni sono: acqua, lubrificanti a base di glicerina e MOLYKOTE® 111.

• Ruotare il modulo di circa un quarto di giro per facilitarne sia l' inserimento che la rimozione. Garantire una buona tenuta tra gli o-ring e la guarnizione del concentrato.

• Mantenere sempre i moduli umidi dopo la prima bagnatura.

• Per prevenire la proliferazione biologica durante i fermi prolungati del sistema, si consiglia di immergere i moduli in una soluzione conservante. Risciacquare dal conservante prima dell'uso.

• A breve termine, la membrana mostra una certa resistenza al cloro (ipoclorito). Tuttavia l'esposizione continua deve essere evitata poichè può danneggiare la membrana.

• I moduli osmotici e di nanofiltrazione FilmTec ™ per acqua potabile, possono essere coperti da una garanzia limitata di tre anni Pro rata (modulo n. 45-D00903-it) estensa anche agli OEM. Tale garanzia tuttavia non è trasferibile. Contattare un rappresentante DuPont per ulteriori informazioni. Se i limiti operativi e le linee guida fornite nel presente Bollettino informativo non vengono seguiti rigorosamente, la Garanzia limitata sarà nulla. L'OEM è pienamente responsabile degli effetti causati da eventuali sostanze chimiche e lubrificanti incompatibili con i moduli. L'uso di tali prodotti chimici o lubrificanti annullerà la garanzia limitata.

Nota normativa

In alcuni paesi, questo prodotto potrebbe essere soggetto a restrizioni su applicazioni potabili; si prega di eseguire tutte le dovute verifiche prima della sua vendita e/o utilizzo.

Additional Important Information

• It is recommended that systems using these elements rinse the elements for 24 hours, prior to first use, to meet NSF/ANSI 58 Standard.

• To ease installation, it is recommended to use a lubricant safe for indirect water contact on all seals. Potential options include water, glycerin based lubricants, and MOLYKOTE® 111 Compound.

• Rotate the element about a quarter turn to ease installation and removal of the element. Ensure good interface between the o-rings and brine seal with their connection surfaces.

• Keep elements moist at all times after initial wetting.

• To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution. Rinse out the preservative before use.

• The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.

• FilmTec™ Home Drinking Water Reverse Osmosis Elements may be covered under the FilmTec™ Reverse Osmosis and Nanofiltration Three-Year Prorated Limited Warranty (Form No. 45-D00903-en) extended to OEMs. Such Limited Warranty is non- transferable. Contact a DuPont representative for more information. If operating limits and guidelines given in this Product Information Bulletin are not strictly followed, the Limited Warranty will be null and void. The OEM is fully responsible for the effects of incompatible chemicals and lubricants on elements. Use of any such chemicals or lubricants will void the Limited Warranty.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ TW30-3812-800

TW30-3812-800 GPD

I moduli FilmTec ™ TW30-3812-800 offrono un alto flusso, un' affidabile reiezione salina e una lunga durata per tutti i sistemi in cui non è prevsto l' uso di sebatoi di accumulo. La tecnologia brevettata di FilmTec ™ che sfrutta il design della membrana e il suo particolare foglio, viene utilizzata per l' ottenimento di prestazioni che consentono una maggiore flessibilità di progettazione nei sistemi a produzione diretta.

Le sue peculiarità sono:

- Flusso superiore fino al 20% a parità di pressione, rispetto ai prodotti concorrenti
- Prestazioni affidabili e costanti nel tempo anche nel trattamento di acque con durezza elevata
- La dimensione del modulo 3812 permette di occupare meno spazio e quindi di realizzare impianti compatti e salva spazio
- Certificazione internazionale NSF
- Spedizione sotto vuoto per lunghi stoccaggi e migliorata gestione

TW30-3812-800 GPD

FilmTec™ TW30-3812-800 Residential RO Elements offer exceptional high flow performance in a compact 3812 element construction while also maintaining the benefit of trusted RO membrane contaminant rejection. The combination of FilmTec™ patented membrane flat sheet technology and engineered element design is harnessed to achieve element performance that enables the design of industry leading tankless RO purifier systems. A summary of the element features includes:

- Up to 20% higher flow versus competitive elements operated at the same pressure
- Stable, reliable performance even when treating high hardness waters
- 3812 element size for space-saving, compact purifier designs
- NSF International safety certification
- Dry shipping for convenient handling and long shelf-life

Product Type

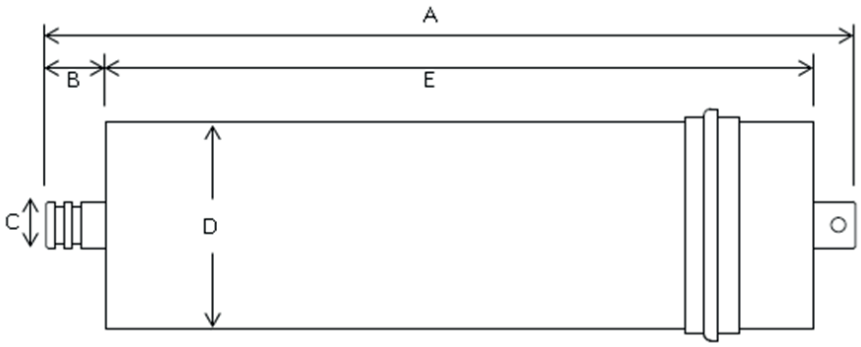
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

	Applied Pressure		Permeate Flow Rate		
FilmTec™ Element	(psig)	(bar)	(GPD)	(L/m)	Typical Stabilized Salt Rejection (%)
TW30-3812-800	70	4.8	800	2.1	98

1. Permeate flow and salt rejection based on the following test conditions: 250 ppm NaCl, 77°F (25°C), pH 8.0, 40% recovery and the specified applied pressure.
2. Minimum salt rejection is 96.0%.
3. Permeate flows for individual elements may vary +25/-15%

Element Dimensions



	A		B		C		D		E	
FilmTec™ Element	(in.)	(mm.)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
TW30-3812-800	11.74	298	0.875	22.2	0.68	17	3.80	96.5	10.25	260.4

Figure 1: Impact of Pressure on Target Permeate Flow (constant temperature, recovery)

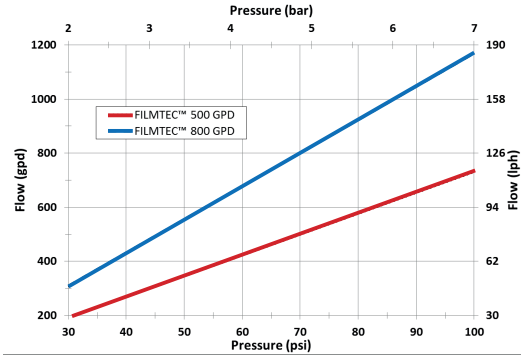
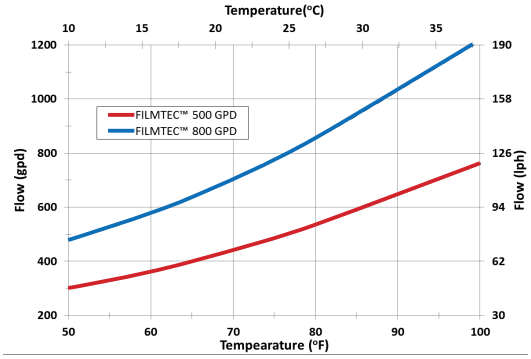


Figure 2: Impact of Temperature on Target Permeate Flow (constant pressure, recovery)



Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	150 psig (10 bar)
Maximum Feed Flow Rate	4.0 gpm (15 lpm)
pH Range, Continuous Operation	2 – 11
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [b]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en) for more information.

Ulteriori e importanti informazioni

• E' raccomandato flussare le membrane per 24 ore prima del loro utilizzo in modo da poter rispettare gli standard imposti dal NSF / ANSI 58.
• Per facilitare l'installazione, si consiglia di utilizzare un lubrificante sicuro per contatto indiretto dell' acqua su tutte le tenute. Le possibili soluzioni sono: acqua, lubrificanti a base di glicerina e MOLYKOTE® 111.
• Ruotare il modulo di circa un quarto di giro per facilitarne sia l' inserimento che la rimozione. Garantire una buona tenuta tra gli o-ring e la guarnizione del concentrato.
• Mantenere sempre i moduli umidi dopo la prima bagnatura.
• Per prevenire la proliferazione biologica durante i fermi prolungati del sistema, si consiglia di immergere i moduli in una soluzione conservante. Risciacquare dal conservante prima dell'uso.
• A breve termine, la membrana mostra una certa resistenza al cloro (ipoclorito). Tuttavia l'esposizione continua deve essere evitata poichè può danneggiare la membrana.
• I moduli osmotici e di nanofiltrazione FilmTec ™ per acqua potabile, possono essere coperti da una garanzia limitata di tre anni Pro rata (modulo n. 45-D00903-it) estensa anche agli OEM. Tale garanzia tuttavia non è trasferibile. Contattare un rappresentante DuPont per ulteriori informazioni. Se i limiti operativi e le linee guida fornite nel presente Bollettino informativo non vengono seguiti rigorosamente, la Garanzia limitata sarà nulla. L'OEM è pienamente responsabile degli effetti causati da eventuali sostanze chimiche e lubrificanti incompatibili con i moduli. L'uso di tali prodotti chimici o lubrificanti annullerà la garanzia limitata.

Nota normativa

In alcuni paesi, questo prodotto potrebbe essere soggetto a restrizioni su applicazioni potabili; si prega di eseguire tutte le dovute verifiche prima della sua vendita e/o utilizzo.

Additional Important Information

• It is recommended that systems using these elements rinse the elements for 24 hours, prior to first use, to meet NSF/ANSI 58 Standard.
• To ease installation, it is recommended to use a lubricant safe for indirect water contact on all seals. Potential options include water, glycerin based lubricants, and MOLYKOTE® 111 Compound.
• Rotate the element about a quarter turn to ease installation and removal of the element. Ensure good interface between the o-rings and brine seal with their connection surfaces.
• Keep elements moist at all times after initial wetting.
• To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution. Rinse out the preservative before use.
• The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.
• FilmTec™ Home Drinking Water Reverse Osmosis Elements may be covered under the FilmTec™ Reverse Osmosis and Nanofiltration Three-Year Prorated Limited Warranty (Form No. 45-D00903-en) extended to OEMs. Such Limited Warranty is non- transferable. Contact a DuPont representative for more information. If operating limits and guidelines given in this Product Information Bulletin are not strictly followed, the Limited Warranty will be null and void. The OEM is fully responsible for the effects of incompatible chemicals and lubricants on elements. Use of any such chemicals or lubricants will void the Limited Warranty.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

MEMBRANE TW RO FILMTEC PER PICCOLE APPLICAZIONI / FILMTEC TW RO MEMBRANES FOR SMALL APPLICATIONS

TW30 SMALL

CARATTERISTICHE GENERALI:
Le membrane ad osmosi inversa (RO) small FILMTEC, offrono la più alta qualità d' acqua osmotizzata per piccoli sistemi RO con produzioni al di sotto di 3,78 litri al minuto (1 gpm).
• le membrane FILMTEC small sono disponibili in varie misure per poter soddisfare ogni tipo di esigenza progettuale.
• la gamma FILMTEC XLE a bassa pressione, garantisce risultati ottimali in tutte quelle applicazione dov' è richiesto basso consumo energetico e costi contenuti dei componenti.
• oltre alla più alta qualità di acqua osmotizzata e ai ridottissimi costi energetici, le membrane FILMTEC Small, offrono affidabilità, alto standard produttivo e pregevole durata nel tempo.

LIMITI E CARATTERISTICHE OPERATIVE:
- Materiale membrana: _____ Polyamide Thin-Film Composite
- Avvolgimento esterno: _____ Nastro
- Temperatura massima di esercizio: _____ 113°F (45°C)
- Pressione massima di esercizio:_____ 600 psig (41 bar)
- Perdita di carico massima: _____ 13 psig (0,9 bar)
- pH Range in continuo : _____ 2 fi 11
- pH Range limitato per lavaggio (30 min.): _____ 1 fi 13
- SDI massimo: _____ 5
- Tolleranza al cloro libero: _____ <0.1 ppm

CERTIFICAZIONI
- FDA CFR 21 177-2550

APPLICAZIONI:
- RO domestici con produzione inferiore ai 3,78 lt/min
- RO per applicazioni tecniche con produzione inferiore ai 3,78 lt/min
- Applicazioni di laboratorio con produzione inferiore ai 3,78 lt/min

INFORMAZIONI GENERALI
- La prima acqua permeata dovrebbe essere scartata. Non utilizzare la prima acqua prodotta per preparare cibi o bevande.
- Tenere le membrane umide dopo la prima bagnatura.
- Se i limti del presente bollettino non vengono osservati scrupolosamente, la garanzia decade.
- Si raccomanda in caso di fermo macchina RO, la conservazione delle membrane tramite prodotto anti-batterico per evitare la formazione di materiale biologico.
- La membrana è resistente per un breve periodo al contatto con cloro (ipoclorito). Il contatto prolungato e superiore agli 0,1 ppm potrebbe danneggiare irreversibilmente la membrana.
- Il cliente è interamente responsabile per l' utilizzo di prodotti chimici di lavaggio ed eventuali lubrificanti incompatibili con la membrana. Tale responsabilità limiterà o annullera la garanzia.
- La massima perdita di carico consentita tra ingresso ed uscita di un vessel è di 2.1 bar (30 psi).
- Evitare sempre contro pressioni statiche sul tubo del permeato.

GUIDA OPERATIVA:
Evitare brusche variazioni di pressione e di flussi al momento della messa in funzione, dello spegnimento sospensione dell'attività, pulizia dell' impianto ecc, per non danneggiare la membrana osmostica. Tra una fermata e una messa in funzione dell' impianto, raccomandiamo che:
• la pressione di alimento deve aumentare gradualmente ed arrivare a pieno regime nel giro di 30-60 secondi.
• la produzione deve aumentare gradualmente ed arrivare a pieno regime non prima dei 15-20 secondi.
• Il permeato ottennuto nella prima ora di funzionamento dell' impianto, dovrebbe essere scartato.

SMALL TW30

GENERAL FEATURES:
The small FILMTEC reverse osmosis (RO) elements offer the highest quality water for small commercial systems purifying less than one gallon per minute (3,78 lt/min) of RO water.
• Small FILMTEC membranes are available in a variety of sizes to meet a wide range of space requirements.
• FILMTEC XLE extra low energy elements operate at the lowest pressure in the industry, resulting in lower energy costs and enabling system builders to use lower cost components.
• In addition to the highest quality water and the lowest energy costs, FILMTEC membranes also deliver savings by providing the industry„s longest lasting and most reliable performance.

OPERATING LIMITS FEATURES:
- Membrane Type: _____ Polyamide Thin-Film Composite
- Wrapped: _____ Tape
- Maximum Operating Temperature: _____ 113°F (45°C)
- Maximum Operating Pressure: _____ 600 psig (41 bar)
- Maximum Pressure Drop: _____ 13 psig (0,9 bar)
- pH Range, Continuous Operation: _____ 2 fi 11
- pH Range, Short-Term Cleaning (30 min.): _____ 1 fi 13
- Maximum Feed Silt Density Index (SDI): _____ 5
- Free Chlorine Tolerancec: _____ <0.1 ppm

CERTIFICATIONS:
- FDA CFR 21 177-2550

APPLICATIONS:
- Small RO sistem less than 1 gpm
- Smal RO technical applications 1 gpm
- Laboratory applications 1 gpm

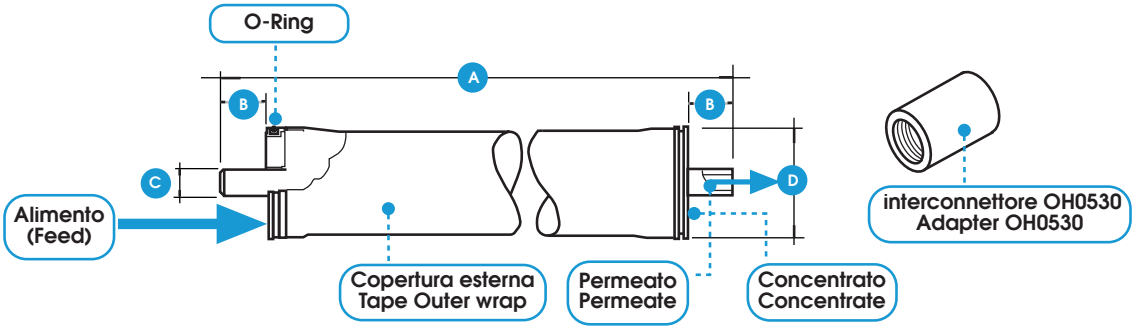
GENERAL INFORMATION:
- The first full tank of permeate should be discarded. Do not use this initial permeate for drinking water or food preparation.
- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements. Their use will void the element limited warranty.
- Maximum pressure drop across an entire pressure vessel (housing) is 30 psi (2.1 bar).
- Avoid static permeate-side backpressure at all times.

OPERATION GUIDELINES:
Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a stand still to operating state is recommended as follows:
• Feed pressure should be increased gradually over a 30-60 second time frame.
• Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.
• Permeate obtained from first hour of operation should be discarded.

Caratteristiche tipiche / *Typical properties*

Product	Part Number	Applied Pressure psig (bar)	Permeate Flow Rate gpd (m^3/d)	Stabilized Salt Rejection (%)
TW30- 2026	80635	225 (15.5)	220 (0.83)	99.5
TW30- 2514	80639	225 (15.5)	200 (0.76)	99.5
TW30- 2521	80641	225 (15.5)	325 (1.23)	99.5
XLE- 2521	154530	100 (6.9)	365 (1.38)	99.0
XLE- 2540	154543	100 (6.9)	850 (3.20)	99.0
TW30- 4014	80605	225 (15.5)	525 (1.99)	99.5
TW30- 4021	80608	225 (15.5)	900 (3.41)	99.5
XLE- 4021	154540	100 (6.9)	1,025 (3.88)	99.0

1. Produzione Permeato e reiezione salina basati sulle seguenti condizioni di test: le Membrane TW30 sono testate con un' acqua a 2000 ppm di NaCl, le membrane XLE a 500 ppm di NaCl, alle pressioni specificate nella tabella sopra, 77°F (25°C) e con i seguenti recuperi: TW30-2026 – 10%, TW30-2521, XLE-2521, TW30-4021, XLE-4021 – 8%,TW30-2514, TW30-4014 – 5%, XLE-2540 – 15% / *Permeate flow and salt rejection based on the following test conditions: TW30 elements are tested on a 2,000 ppm NaCl feed stream, XLE performance based on a 500ppm NaCl feed stream, pressure specified above, 77°F (25°C) and the following recovery rates; TW30-2026 – 10%, TW30-2521, XLE-2521, TW30-4021, XLE-4021 – 8%,TW30-2514, TW30-4014 – 5%,* XLE-2540 – 15%.
2. La produzione del permeato può variare da membrana a membrana del +/-20%. / *Permeate flows for individual elements may vary +/-20%.*
3. Per motivi di miglioramento del prodotto, i dati possono subire delle modifiche periodiche / *For the purpose of improvement, specifications may be updated periodically.*



Dimensioni / Dimensions

Prodotto Product	Portata Massima in Allimento gpm (m3/h) Maximum Feed Flow Rate gpm (m3/h)	A inch (mm)	B inch (mm)	C inch (mm)	D inch (mm)
TW30-2026	5 (1.1)	26.0 (660)	1.18 (30)	0.68 (17)	1.8 (46)
TW30-2514	6 (1.4)	14.0 (356)	1.19 (30)	0.75 (19)	2.4 (61)
TW30-2521	6 (1.4)	21.0 (533)	1.19 (30)	0.75 (19)	2.4 (61)
XLE-2521	6 (1.4)	21.0 (533)	1.19 (30)	0.75 (19)	2.4 (61)
XLE-2540	6 (1.4)	40.0 (1,016)	1.19 (30)	0.75 (19)	2.4 (61)
TW30-4014	14 (3.2)	14.0 (356)	1.05 (27)	0.75 (19)	3.9 (99)
TW30-4021	14 (3.2)	21.0 (533)	1.05 (27)	0.75 (19)	3.9 (99)
XLE-4021	14 (3.2)	21.0 (533)	1.05 (27)	0.75 (19)	3.9 (99)

1 inch = 25.4 mm

Ulteriori e importanti informazioni

Si raccomanda di flussare le membrane prima della messa in servizio. Una corretta procedura di start-up dell' impianto ad osmosi inversa è essenziale per preparare le membrane al normale servizio operativo. La procedura previene danni ai moduli che possono essere causati da sovra alimentazione o shock idrulici. La corretta sequenza di avvio, aiuta a garantire che i parametri del sistema siano conformi alle specifiche progettuali raggiungendo così gli obiettivi di qualità e produttività del sistema

Prima di iniziare le procedure di start-up, occorre che il pretrattamento sia efficiente, che i moduli osmotici siano inseriti nei vessels e che i sistemi di controllo e calibrazione funzionino perfettamente.

Per ulteriori informazioni fare riferimento alla documentazione informativa presente sul sito web www.dupont.com/ e intitolata "Sequenza di avvio" (Modulo n. 45-D01609-it).

Additional Important Information

It is recommended that systems using these elements rinse Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence
(Form No. 45-D01609-en) for more information.

MEMBRANE RO FILMTEC 4040 PER MEDIE APPLICAZIONI COMMERCIALI/ 4040 FILMTEC RO MEMBRANES FOR MEDIUM COMMERCIAL APPLICATIONS

4040

CARATTERISTICHE GENERALI:
Le membrane ad osmosi inversa (RO) 4040 FILMTEC, sono disponibili per diverse applicazioni per incontrare tutte le molteplici esigenze del cliente, dalla più alta qualità d' acqua osmotizzata possibile ai più bassi costi di gestione e totali.
• FILMTEC XLE-4040 è la membrana più produttiva, con la pressione aplicata minore e con i più bassi costi di gestione.
• FILMTEC TW30-4040 è la membrana che garantisce la più alta qualità possibile di acqua permeata. Essa ha l' avvolgimento esterno non rigido (la compattezza è data da una nastratura esterna non rigida). Questa particolarità rende gli impianti più economici, con l' unico limite di non poter alloggiare più di due membrane all' interno di uno stesso vessel.

LIMITI E CARATTERISTICHE OPERATIVE:
- Materiale membrana: _____ Polyamide Thin-Film Composite
- Avvolgimento esterno: _____ Nastro
- Temperatura massima di esercizio: _____ 113°F (45°C)
- Pressione massima di esercizio:_____ 600 psig (41 bar)
- Portata massima in alimento: _____ 3.1 m3/h (14 gpm)
- Perdita di carico massima : _____ 13 psig (0,9 bar)
- pH Range in continuo : _____ 2 fi 11
- pH Range limitato per lavaggio (30 min.): _____ 1 fi 12
- SDI massimo: _____ 5
- Tolleranza al cloro libero: _____ <0.1 ppm

CERTIFICAZIONI
- FDA CFR 21 177-2550

APPLICAZIONI:
- RO per applicazioni industriali
- RO per applicazioni tecniche con produzione medio piccola
- Applicazioni di laboratorio

INFORMAZIONI GENERALI
- La prima acqua permeata dovrebbe essere scartata. Non utilizzare la prima acqua prodotta per preparare cibi o bevande.
- Tenere le membrane umide dopo la prima bagnatura.
- Se i limti del presente bollettino non vengono osservati scrupolosamente, la garanzia decade.
- Si raccomanda in caso di fermo macchina RO, la conservazione delle membrane tramite prodotto anti-batterico per evitare la formazione di materiale biologico.
- La membrana è resistente per un breve periodo al contatto con cloro (ipoclorito). Il contatto prolungato e superiore agli 0,1 ppm potrebbe danneggiare irreversibilmente la membrana.
- Il cliente è interamente responsabile per l' utilizzo di prodotti chimici di lavaggio ed eventuali lubrificanti incompatibili con la membrana. Tale responsabilità limiterà o annullera la garanzia.
- La massima perdita di carico consentita tra ingresso ed uscita di un vessel è di 2.1 bar (30 psi).
- Evitare sempre contro pressioni statiche sul tubo del permeato.

GUIDA OPERATIVA:
Evitare brusche variazioni di pressione e di flussi al momento della messa in funzione, dello spegnimento sospensione dell'attività, pulizia dell' impianto ecc, per non danneggiare la membrana osmostica. Tra una fermata e una messa in funzione dell' impianto, raccomandiamo che:
• la pressione di alimento deve aumentare gradualmente ed arrivare a pieno regime nel giro di 30-60 secondi.
• la produzione deve aumentare gradualmente ed arrivare a pieno regime non prima dei 15-20 secondi.
• Il permeato ottennuto nella prima ora di funzionamento dell' impianto, dovrebbe essere scartato.

4040

GENERAL FEATURES:
A complete range of FILMTEC 4040 size elements is available to meet a wide variety of customer needs for commercial applications, from the highest purity water to the lowest total system costs.
• FILMTEC XLE-4040 is the most productive, lowest pressure RO membrane available, delivering the lowest total system cost.
• FILMTEC TW30-4040 is the industry standard for reliable operation and production of the highest quality water. Tape-wrapped elements are built with the same high quality membranes and materials of construction as industrial elements, without the hard outer shell. This makes them more economical for commerical systems with one or two elements per housing.

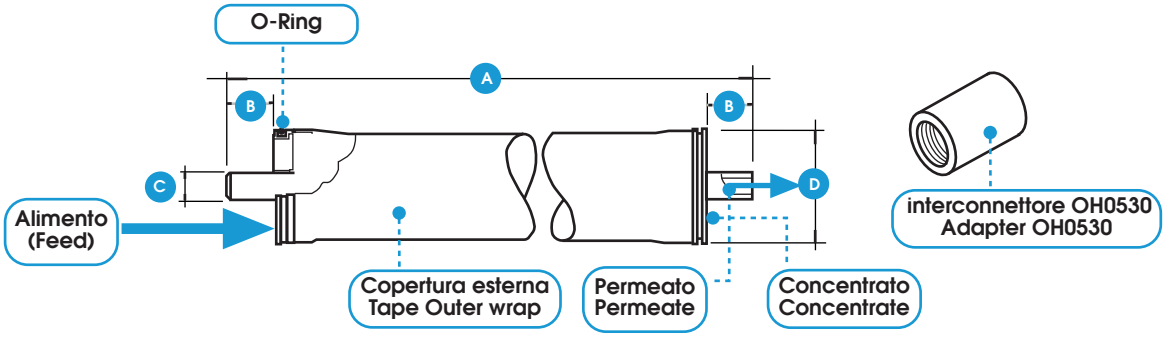
OPERATING LIMITS FEATURES:
- Membrane Type: _____ Polyamide Thin-Film Composite
- Wrapped: _____Tape
- Maximum Operating Temperature: _____ 113°F (45°C)
- Maximum Operating Pressure: _____ 600 psig (41 bar)
- Maximum Feed Flow Rate: _____ 14 gpm (3.1 m3/h)
- Maximum Pressure Drop: _____ 13 psig (0,9 bar)
- pH Range, Continuous Operation: _____ 2 fi 11
- pH Range, Short-Term Cleaning (30 min.): _____ 1 fi 12
- Maximum Feed Silt Density Index (SDI): _____ 5
- Free Chlorine Tolerancec: _____ <0.1 ppm

CERTIFICATIONS:
- FDA CFR 21 177-2550

APPLICATIONS:
- Industrial RO sistem
- Small and Medium RO technical applications
- Laboratory applications

GENERAL INFORMATION:
- The first full tank of permeate should be discarded. Do not use this initial permeate for drinking water or food preparation.
- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements. Their use will void the element limited warranty.
- Maximum pressure drop across an entire pressure vessel (housing) is 30 psi (2.1 bar).
- Avoid static permeate-side backpressure at all times.

OPERATION GUIDELINES:
Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a stand still to operating state is recommended as follows:
• Feed pressure should be increased gradually over a 30-60 second time frame.
• Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.
• Permeate obtained from first hour of operation should be discarded.



Dimensioni / Dimensions

Prodotto Product	Portata Massima in Allimento gpm (m3/h) Maximum Feed Flow Rate gpm (m3/h)	A inch (mm)	B inch (mm)	C inch (mm)	D inch (mm)
XLE-4040	14 (3.1)	40.0 (1,016)	1.05 (26.7)	0.75 (19)	3.9 (99)
TW30-4040	14 (3.1)	40.0 (1,016)	1.05 (26.7)	0.75 (19)	3.9 (99)

1 inch = 25.4 mm

Specifiche del prodotto / Product Specifications

Modello Model	Area filtrante ft^2 (m^2) Active area ft^2 (m^2)	Spessore Spaziatori (mil) Feed Spacer Thickness (mil)	Pressione applicata psig (bar) Applied Pressure psig (bar)	Produzione Permeato gpd (m3/g) Permeate Flow Rate gpd (m3/g)	Reiezione Stabilizzata (%) Stabilized Salt Rejection (%)
XLE-4040	87 (8.1)	28	100 (6.9)	2,600 (9.8)	99.0
TW30-4040	87 (8.1)	34	225 (15.5)	2,400 (9.1)	99.5

1. Produzione Permeato e reiezione salina basati sulle seguenti condizioni di test: 77°F (25°C), recupero del 15% alle pressioni specificate sopra. Le TW30 4040 sono testate a con acqua a 2000 ppm di NaCl. Le membrane XLE4040 sono testate a 500 ppm di NaCl
   Permeate flow and salt rejection based on the following test conditions: 77°F (25°C), 15% recovery and the specified applied pressure. TW30-4040 is tested on a 2,000 ppm NaCl feed stream. XLE-4040 are tested on a 500 ppm NaCl feed stream.
2. La produzione del permeato può variare da membrana a membrana del +/-20% / *Permeate flows for individual elements may vary +/-20%.*
3. Per motivi di miglioramento del prodotto, i dati possono subire delle modifiche periodiche / *For the purpose of improvement, specifications may be updated periodically.*

Ulteriori e importanti informazioni

Si raccomanda di flussare le membrane prima della messa in servizio. Una corretta procedura di start-up dell' impianto ad osmosi inversa è essenziale per preparare le membrane al normale servizio operativo. La procedura previene danni ai moduli che possono essere causati da sovra alimentazione o shock idrulici. La corretta sequenza di avvio, aiuta a garantire che i parametri del sistema siano conformi alle specifiche progettuali raggiungendo così gli obiettivi di qualità e produttività del sistema

Prima di iniziare le procedure di start-up, occorre che il pretrattamento sia efficiente, che i moduli osmotici siano inseriti nei vessels e che i sistemi di controllo e calibrazione funzionino perfettamente.

Per ulteriori informazioni fare riferimento alla documentazione informativa presente sul sito web www.dupont.com/ e intitolata "Sequenza di avvio" (Modulo n. 45-D01609-it).

Additional Important Information

It is recommended that systems using these elements rinse Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence
(Form No. 45-D01609-en) for more information.

MEMBRANE RO FILMTEC LCHR & LCLE 4040 / LCHR & LCLE FILMTEC RO MEMBRANES

LCHR & LCLE 4040

La gamma FilmTec ™ LC 4040 è disponibile per soddisfare una vasta gamma di esigenze in applicazioni commerciali, dalla produzione di acqua ad elevata purezza ai bassi costi totali. La produzione completamente automatizzata di DuPont, consente di avere prodotti con il più alto standard produttivo presente sul mercato, riducendo al minimo i costi generali dei sistemi.

- LC HR-4040 è una membrana all' avanguardia che produce acqua di alta qualità.
- LC LE-4040 produce un permeato di alta qualità a bassa pressione in condizioni di acque critiche, tramite una tecnologia di proprietaria DuPont per basso consumo energetico.

LCHR & LCLE 4040

FilmTec™ LC 4040 product range are available to meet a wide variety of customer needs in commercial applications, from producing high purity water to delivering low total system costs. DuPont's fully automated element production enables the most consistent products in the industry that minimizes the total cost of ownership of water treatment systems.

- LC HR-4040 produces high quality water with our state of the art RO membrane.
- LC LE-4040 delivers high quality water at low pressure at harsh water conditions, using DuPont's innovative, proprietary technology for low energy applications.

Product Type

Spiral-wound element with polyamide thin-film composite membrane

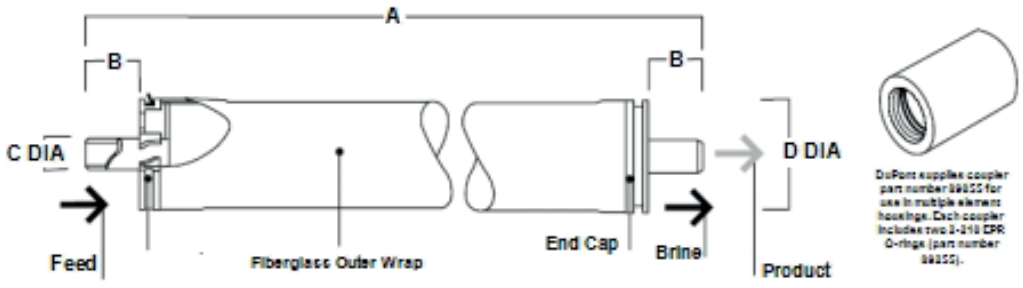
Typical Properties

Product	Part Number Dry (Wet)	Feed Spacer Thickness (mil)	Permeate Flow Rate gpd (m^3/d)	Min. Salt Rejection (%)	Stabilized Salt Rejection (%)
LC HR-4040	343771 / (343770)	28	2900 (11)	99.5	99.7
LC LE-4040	356603 / (356602)	28	2500 (9.5)	99.0	99.2

1. Permeate flow and salt rejection based on the following test conditions: 2000 ppm NaCl, 77°F (25°C), 15% recovery, pH 8, and applied pressure 225 psig for LC HR and 125 psig for LC LE.
2. Permeate flows for individual elements may vary +/-15%.
3. For the purpose of improvement, specifications may be updated periodically.

LC HR-4040	Solute	NH_4^+	NO_3^-	SiO_2	Boron
	Typical rejection (%)	98.8	98.2	99.8	80.0

Element Dimensions



Product	A Inches (mm)	B Inches (mm)	C Inches (mm)	D Inches (mm)
LC HR-4040 and LC LE-4040	40.00 (1016)	1.05 (26.7)	0.75 (19)	3.9 (99)

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of midsize elements (Form No. 45-D01588-en).
2. LC HR-4040 and LC HRLE-4040 Elements fit nominal 4-inch I.D. pressure vessel.

Operating and Cleaning Limits

Membrane type	Polyamide Thin-Film Composite
Maximum operating temperature[a]	113°F (45°C)
Maximum operating pressure	600 psig (41 bar)
Maximum pressure drop	15 psig (1.0 bar)
Maximum feed flow rate, gpm (m^3/h)	16 gpm (3.6 (m^3/h))
pH range	
Continuous operation[a]	2 - 11
Short-term cleaning[b]	1 – 13
Maximum Feed Silt Density Index	SDI 5
Free chlorine concentration[c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont recommends removing residual free chlorine and other oxidants by pretreatment prior to membrane exposure. Please refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en) for more information.

General Information

Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence (Form No. 45-D01609-en) for more information.

Ulteriori e importanti informazioni

Si raccomanda di flussare le membrane prima della messa in servizio. Una corretta procedura di start-up dell' impianto ad osmosi inversa è essenziale per preparare le membrane al normale servizio operativo. La procedura previene danni ai moduli che possono essere causati da sovra alimentazione o shock idrulici. La corretta sequenza di avvio, aiuta a garantire che i parametri del sistema siano conformi alle specifiche progettuali raggiungendo così gli obiettivi di qualità e produttività del sistema

Prima di iniziare le procedure di start-up, occorre che il pretrattamento sia efficiente, che i moduli osmotici siano inseriti nei vessels e che i sistemi di controllo e calibrazione funzionino perfettamente.

Per ulteriori informazioni fare riferimento alla documentazione informativa presente sul sito web www.dupont.com/ e intitolata "Sequenza di avvio" (Modulo n. 45-D01609-it).

Additional Important Information

It is recommended that systems using these elements rinse Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence

(Form No. 45-D01609-en) for more information.

MEMBRANE RO FILMTEC BW PER MEDIE APPLICAZIONI / BW FILMTEC RO MEMBRANES FOR MEDIUM APPLICATIONS

BW

CARATTERISTICHE GENERALI:
Le membrane ad osmosi inversa (RO) BW FILMTEC, sono disponibili per diverse applicazioni e consigliati per medi impianti industriali.
• FILMTEC BW30-4040 è la membrana che garantisce la più alta qualità possibile di acqua permeata.
• FILMTEC BW30-2540 è la membrana che garantisce la più alta qualità possibile di acqua permeata nei sistemi con produzione non superiore agli 0.2 m3/h (1 gpm). Essa ha l' avvolgimento esterno rigido che permette di alloggiare più di due membrane all' interno di uno stesso vessel nei sistemi con alte perdite di carico.

LIMITI E CARATTERISTICHE OPERATIVE:
- Materiale membrana: _____ Polyamide Thin-Film Composite
- Avvolgimento esterno: _____Vetroresina
- Temperatura massima di esercizio: _____ 113°F (45°C)
- Pressione massima di esercizio: _____ 600 psig (41 bar)
- Portata massima in alimento:
• 4040: _____ 16 gpm (3.6 m3/h)
• 2540: _____ 6 gpm (1.4 m3/h)
- Perdita di carico massima: _____ 15 psig (1,0 bar)
- pH Range in continuo : _____ 2 fi 11
- pH Range limitato per lavaggio (30 min.): _____ 1 fi 12
- SDI massimo: _____ 5
- Tolleranza al cloro libero: _____ <0.1 ppm

CERTIFICAZIONI
- FDA CFR 21 177-2550

APPLICAZIONI:
- RO per applicazioni industriali con più membrane in un vessel
- RO per applicazioni tecniche con media produzione
- Applicazioni di laboratorio

INFORMAZIONI GENERALI
- La prima acqua permeata dovrebbe essere scartata. Non utilizzare la prima acqua prodotta per preparare cibi o bevande.
- Tenere le membrane umide dopo la prima bagnatura.
- Se i limti del presente bollettino non vengono osservati scrupolosamente, la garanzia decade.
- Si raccomanda in caso di fermo macchina RO, la conservazione delle membrane tramite prodotto anti-batterico per evitare la formazione di materiale biologico.
- La membrana è resistente per un breve periodo al contatto con cloro (ipoclorito). Il contatto prolungato e superiore agli 0,1 ppm potrebbe danneggiare irreversibilmente la membrana.
- Il cliente è interamente responsabile per l' utilizzo di prodotti chimici di lavaggio ed eventuali lubrificanti incompatibili con la membrana. Tale responsabilità limiterà o annullera la garanzia.
- La massima perdita di carico consentita tra ingresso ed uscita di un vessel è di 3.5 bar (50 psi).
- Evitare sempre contro pressioni statiche sul tubo del permeato.

GUIDA OPERATIVA:
Evitare brusche variazioni di pressione e di flussi al momento della messa in funzione, dello spegnimento o sospensione dell'attività, pulizia dell' impianto ecc, per non danneggiare la membrana osmotica. Tra una fermata e una messa in funzione dell' impianto, raccomandiamo che:
• la pressione di alimento deve aumentare gradualmente ed arrivare a pieno regime nel giro di 30-60 secondi.
• la produzione deve aumentare gradualmente ed arrivare a pieno regime non prima dei 15-20 secondi.
• Il permeato ottennuto nella prima ora di funzionamento dell' impianto, dovrebbe essere scartato.

BW

GENERAL FEATURES:
FILMTEC brackish water reverse osmosis membrane elements provide consistent,outstanding system performance in light industrial applications.
• FILMTEC BW30-4040 is the industry standard for reliable operation and production of the highest quality water.
• FILMTEC BW30-2540 elements are designed for systems smaller than 1 gpm (0.2 m3/h) offering a hard shell exterior for extra strength. Elements with a hard shell exterior are recommended for systems with multiple-element housings containing three or more membranes, as they are designed to with stand higher pressure drops.

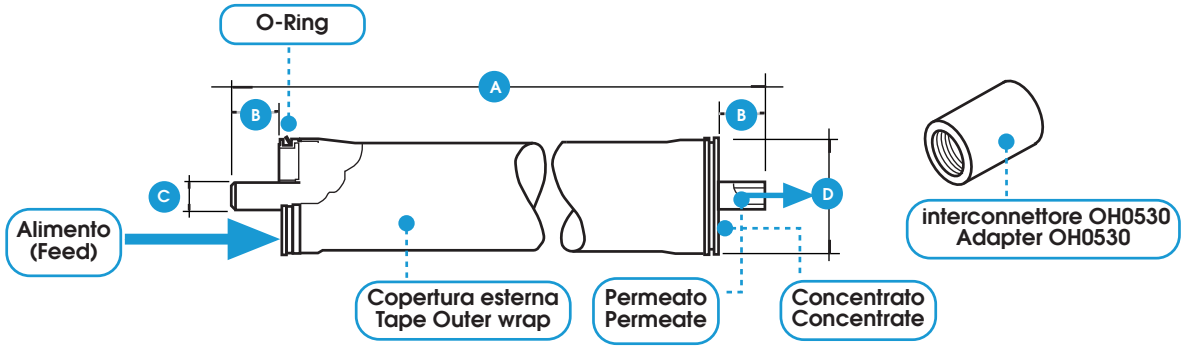
OPERATING LIMITS FEATURES:
- Membrane Type: _____ Polyamide Thin-Film Composite
- Wrapped: _____Fiberglass
- Maximum Operating Temperature: _____ 113°F (45°C)
- Maximum Operating Pressure: _____ 600 psig (41 bar)
- Maximum Feed Flow Rate:
• 4040: _____ 16 gpm (3.6 m3/h)
• 2540: _____ 6 gpm (1.4 m3/h)
- Maximum Pressure Drop: _____ 15 psig (1,0 bar)
- pH Range, Continuous Operation: _____ 2 fi 11
- pH Range, Short-Term Cleaning (30 min.): _____ 1 fi 12
- Maximum Feed Silt Density Index (SDI): _____ 5
- Free Chlorine Tolerancec: _____ <0.1 ppm

CERTIFICATIONS:
- FDA CFR 21 177-2550

APPLICATIONS:
- Industrial RO sistem multiple-element housings
- Medium RO technical applications
- Laboratory applications

GENERAL INFORMATION:
- The first full tank of permeate should be discarded. Do not use this initial permeate for drinking water or food preparation.
- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements. Their use will void the element limited warranty.
- Maximum pressure drop across an entire pressure vessel (housing) is 50 psi (3.5 bar).
- Avoid static permeate-side backpressure at all times.

OPERATION GUIDELINES:
Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a stand still to operating state is recommended as follows:
• Feed pressure should be increased gradually over a 30-60 second time frame.
• Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.
• Permeate obtained from first hour of operation should be discarded.



Dimensioni / Dimensions

Prodotto Product	Portata Massima in Allimento gpm (m3/h) Maximum Feed Flow Rate gpm (m3/h)	A inch (mm)	B inch (mm)	C inch (mm)	D inch (mm)
BW30-4040	16 (3.6)	40.0 (1,016)	1.05 (26.7)	0.75 (19)	3.9 (99)
BW30-2540	6 (1.4)	40.0 (1,016)	1.19 (30.2)	0.75 (19)	2.4 (61)

1 inch = 25.4 mm

Specifiche del prodotto / Product Specifications

Modello Model	Area filtrante ft² (m²) Active area ft² (m²)	Pressione applicata psig (bar) Applied Pressure psig (bar)	Produzione Permeato gpd (m3/g) Permeate Flow Rate gpd (m3/g)	Reiezione Stabilizzata (%) Stabilized Salt Rejection (%)
BW30-4040	87 (8.1)	225 (15.5)	2,400 (9.1)	99.5
BW30-2540	28 (2.6)	225 (15.5)	1,000 (3.8)	99.5

1. Produzione Permeato e reiezione salina basati sulle seguenti condizioni di test: 77°F (25°C), pH 8, recupero del 15% alle pressioni specificate sopra, acqua a 2000 ppm di NaCl. / *Permeate flow and salt rejection based on the following test conditions: 77°F (25°C), pH 8, 15% recovery and the specified applied pressure, water at 2,000 ppm NaCl feed stream.*
2. La produzione del permeato può variare da membrana a membrana del +/-20%. / *Permeate flows for individual elements may vary +/-20%.*
4. Per motivi di miglioramento del prodotto, i dati possono subire delle modifiche periodiche / *For the purpose of improvement, specifications may be updated periodically.*

Ulteriori e importanti informazioni

Si raccomanda di flussare le membrane prima della messa in servizio. Una corretta procedura di start-up dell' impianto ad osmosi inversa è essenziale per preparare le membrane al normale servizio operativo. La procedura previene danni ai moduli che possono essere causati da sovra alimentazione o shock idrulici. La corretta sequenza di avvio, aiuta a garantire che i parametri del sistema siano conformi alle specifiche progettuali raggiungendo così gli obiettivi di qualità e produttività del sistema

Prima di iniziare le procedure di start-up, occorre che il pretrattamento sia efficiente, che i moduli osmotici siano inseriti nei vessels e che i sistemi di controllo e calibrazione funzionino perfettamente.

Per ulteriori informazioni fare riferimento alla documentazione informativa presente sul sito web www.dupont.com/ e intitolata "Sequenza di avvio" (Modulo n. 45-D01609-it).

Additional Important Information

It is recommended that systems using these elements rinse Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence
(Form No. 45-D01609-en) for more information.

FilmTec™ BW30-365

BW30-365

BW30-365

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque critiche e desiderano comuque ottenere elevate prestazioni e lunga durata dei moduli.

Con decennale e comprovata esperienza, FilmTec ™ BW30-365:

• Fornisce acqua di alta qualità riducendo al minimo i costi unitari

• Offre i migliori risultati di pulizia chimica, robustezza e durata grazie all' ampio intervallo di pH di lavaggio (1 - 13) e all' assistenza tecnica di Hytek e dei tecnici DuPont

Ideal for: reverse osmosis plant managers and operators dealing with challenging water and seeking consistent, high performance and long element life.

With decades of proven performance, FilmTec™ BW30-365:

• Delivers high quality permeate water while minimizing unit cost

• Offers the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1 – 13) tolerance and the support of DuPont technical representatives

Product Type

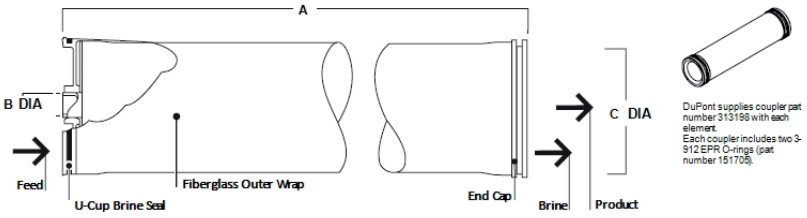
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30-365	365	34	34	9,500	36	99.5	99.0

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 225 psi (15.5 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than 15% below the value shown.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm) 1 inch = 25.4 mm

FilmTec™ Element	A (in.)	A (mm)	B (in.)	B (mm)	C (in.)	C (mm)
BW30-365	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

Product Stewardship

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Please be aware of the following:

- 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.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW30-400

BW30-400

FilmTec ™ BW30-400 la membrana RO per acqua salmastra ad alta reiezione a grande superficie.
FilmTec ™ BW30-400 è il prodotto da scegliere quando è richiesta la massima qualità di permeato. Rappresenta il primo modulo a membrana da 400 piedi quadri lanciato sul mercato e ad oggi continua ad essere ampiamente utilizzato per gli impianti dove capitale e produttività sono fattori primari.
• L' alta tecnologia di produzione automatizzata messa in campo da DuPont garantisce prestazioni costanti da elemento a elemento e anno dopo anno.
• I moduli FilmTec ™ BW30-400 forniscono un elevato flusso initamente ad un' alta reiezione senza produzione di clorati in fase produttiva. Questo è uno dei motivi per cui i moduli FilmTec ™ sono più durevoli e possono essere lavati in un intervallo di pH più ampio (pH 1-13) rispetto ad altri elementi RO.
• Con decennale e comprovata esperienza, FilmTec ™ BW30-400 è il prodotto su cui puoi realmente affidarti per anni senza avere problemi operativi.

BW30-400

FilmTec™ BW30-400 High Rejection, High Surface Area Brackish Water RO Element.
The FilmTec™ BW30-400 is the product of choice when the highest quality permeate is required. It was the first 400 square foot membrane element on the market and continues to be widely used in new equipment and retrofits where system capital and productivity are factors.
• DuPont's superior automated manufacturing technology results in the most consistent performance element-to-element and year-after-year.
• FilmTec™ BW30-400 Elements deliver high flow and high rejection without being chlorinated during the manufacturing process. This is one reason why FilmTec™ Elements are more durable and may be cleaned over a wider pH range (pH 1-13) than other RO elements.
• With more than a decade of proven performance, FilmTec™ BW30-400 is the product you can rely on for years of trouble-free operation.

Product Type

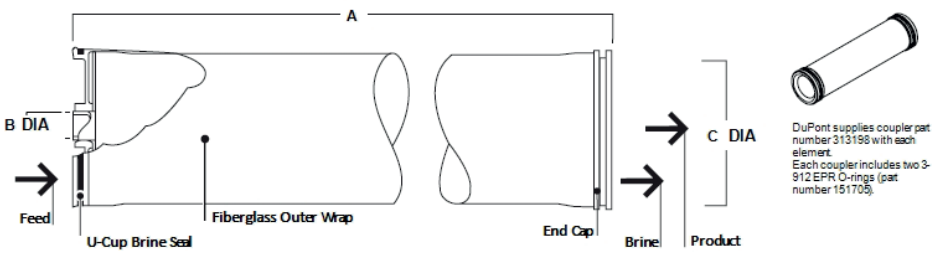
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Part number	Active area ft² (m²)	Feed spacer thickness (mil)	Permeate flow rate gpd (m³/d)	Stabilized salt rejection (%)	Minimum salt rejection (%)
BW30-400	98650	400 (37)	28	10,500 (40)	99.5%	99.0%

1. Permeate flow and salt rejection based on the following standard conditions: 2,000 ppm NaCl, 225 psi (15.5 bar), 77°F (25°C), pH 8 and 15% recovery.
2. Flow rates for individual elements may vary but will be no more than 15% below the value shown.
3. Sales specifications may vary as design revisions take place.
4. Active area guaranteed +/-3%. Active area as stated by DuPont is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)			1 inch = 25.4 mm
FilmTec™ Element	A	B	C
BW30-400	40.0 (1,016)	1.125 ID (29)	7.9 (201)

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en) and recommended element recovery rates for various feed sources.
2. Element to fit nominal 8.0-inch (203 mm) I.D. pressure vessel.

Suggested Operating Conditions

Membrane Type	Polyamide Thin-Film Composite
Maximum Operating Temperature[a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation[a]	2 - 11
Short-Term Cleaning (30 min.)[b]	1 - 13
Maximum Feed Flow	70 gpm (15.9 m^3/hr)
Maximum Feed Silt Density Index	SDI 5
Free Chlorine Tolerance[c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en) for more information.

Important Information

Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence (Form No. 45-D01609-en) for more information.

Operation Guidelines

Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a standstill to operating state is recommended as follows:

- Feed pressure should be increased gradually over a 30-60 second time frame.
- Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.

General Information

- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the FilmTec™ Reverse Osmosis and Nanofiltration Three-Year Prorated Limited Warranty (Form No. 45-D00903-en) will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements.
- Maximum pressure drop across an entire pressure vessel (housing) is 50 psi (3.4 bar).
- Avoid static permeate-side backpressure at all times.

FilmTec™ BW30-400/34

BW30-400/34

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque reflue e di una certa criticità che desiderano comuque ottenere elevate prestazioni e lunga durata dei moduli. FilmTec ™ BW30-400 / 34 offre prestazioni comprovate come:

- Fornire un permeato di alta qualità riducendo al minimo le spese in conto capitale
- Offrire alte prestazion sul lavaggio chimico, robustezza e durata e grazie al più ampio intervallo di pH (1-13) e al supporto dei tecnici Hytek e consulenti FilmTec ™

BW30-400/34

Ideal for: reverse osmosis plant managers and operators dealing with challenging waters and wastewaters and looking for consistency, high performance, long element life and increased productivity. Offering proven performance, FilmTec™ BW30-400/34:

- Delivers high quality permeate water while minimizing CAPEX
- Offers highly effective cleaning performance, robustness and durability due to its widest cleaning pH range (1 – 13) tolerance and the support of FilmTec™ technical representatives

Product Type

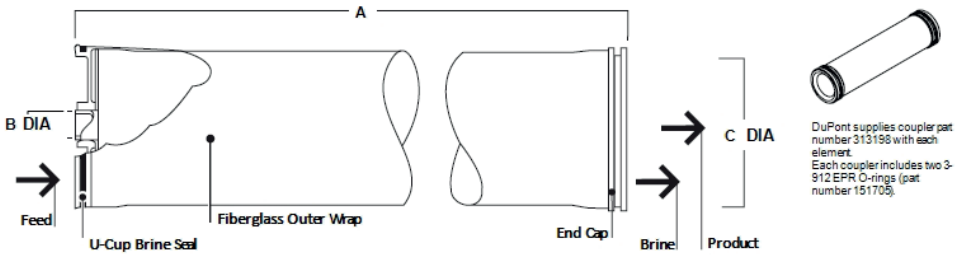
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30-400/34	400	37	34	10,500	40	99.5	99.0

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 225 psi (15.5 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than 15% below the value shown.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ±3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
BW30-400/34	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

Product Stewardship

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Please be aware of the following:

- 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.
- Permeate obtained from the first hour of operation should be discarded.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW30-400/34i

BW30-400/34i

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque reflue e di una certa criticità che desiderano comuque ottenere elevate prestazioni e lunga durata dei moduli. FilmTec ™ BW30-400 / 34i offre prestazioni comprovate come:

- Fornire un permeato di alta qualità riducendo al minimo le spese in conto capitale
- Offrire alte prestazion sul lavaggio chimico, robustezza e durata e grazie al più ampio intervallo di pH (1-13) e al supporto dei tecnici Hytek e consulenti FilmTec ™
- Tappi terminali con sistema interlock iLEC ™, che riducono i costi operativi del sistema e il rischio di perdite dagli o-ring che possono esser causa di scarsa qualità dell'acqua

BW30-400/34i

Ideal for: reverse osmosis plant managers and operators dealing with challenging waters and wastewaters and looking for consistency, high performance, long element life and increased productivity. Offering proven performance, FilmTec™ BW30-400/34i:

- Delivers high quality permeate water while minimizing CAPEX
- Offers highly effective cleaning performance, robustness and durability due to its widest cleaning pH range (1 – 13) tolerance and the support of FilmTec™ technical representatives
- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

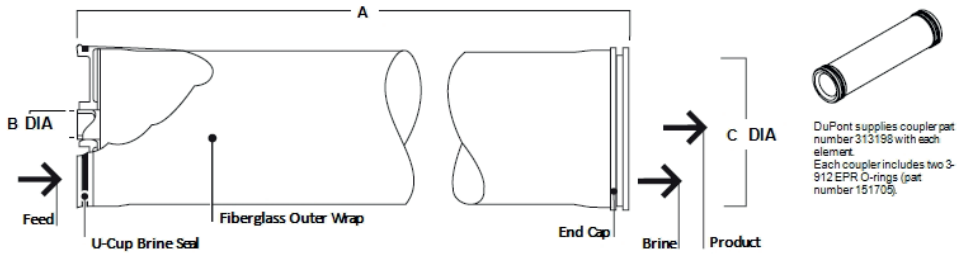
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30-400/34	400	37	34	10,500	40	99.5	99.0

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 225 psi (15.5 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than 15% below the value shown.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
BW30-400/34	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

Product Stewardship

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Please be aware of the following:

- 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.
- Permeate obtained from the first hour of operation should be discarded.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ XLE-440

XLE-440

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque con sistema di pre trattamento ottimizzato che cercano alta qualità e bassi costi operativi.
XLE-440 è la membrana della gamma FilmTec ™ che lavora alla pressione più bassa:

- Fornisce prestazioni con bassi costi energetici e più produttività
- Riduce i costi (CAPEX) tramite un minor numero di membrane, tramite i costi di pompaggio ed un area filtrante di 440 ft2.
- Offrire una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, iltutto supportato dal servizio tecnico Hytek e DuPont

XLE-440

Ideal for: reverse osmosis plant managers and operators dealing with controlled-pre-treatment and seeking high-quality permeate water at low operating costs.
FilmTec™ XLE-440, the lowest pressure FilmTec™ RO Element:

- Provides lower energy costs and more productivity, especially in cold waters
- Minimizes equipment CAPEX in designs with savings in elements and pumping due to the 440 ft2 active area
- Delivers the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) tolerance and the support of FilmTec™ technical representatives

Product Type

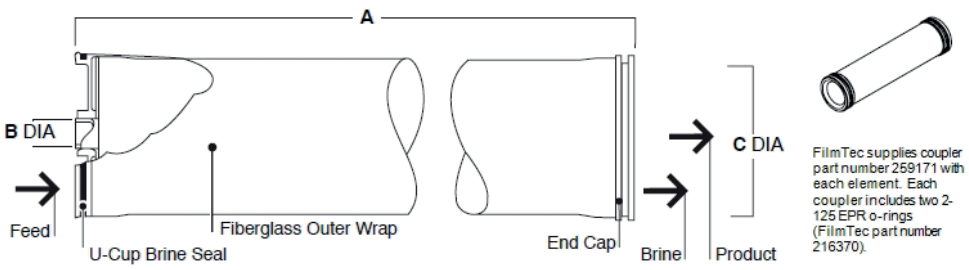
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
XLE-440	440	41	28	14,000	53	99.0%	97.0%

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 125 psi (8.6 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than +15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ±5%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
XLE-440	40.0	1,016	1.50 ID	38 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

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Please be aware of the following:

- 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.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW30XFR-400/34

BW30XFR-400/34

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque reflue e di una certa criticità che desiderano comuque ottenere elevate prestazioni, lunga durata dei moduli, alte produzioni e quaità uniti ad un' eccellente rsistenza agli sporcamenti.

FilmTec™ BW30XFR-400/34 offre prestazioni comprovate come:

• Alta qualità del permeato con abbattimento dei costi CAPEX e OPEX

• Offrire una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, iltutto supportato dal servizio tecnico Hytek e DuPont

BW30XFR-400/34

Ideal for: reverse osmosis plant managers and operators dealing with challenging waters and wastewaters and seeking consistent high performance, long element life, increased productivity and higher water quality coupled with excellent fouling resistance.

With proven performance, FilmTec™ BW30XFR-400/34:

• Delivers the highest quality permeate water while minimizing CAPEX and OPEX

• Offers the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1 – 13) and chemical tolerance, and the support of DuPont representatives

Product Type

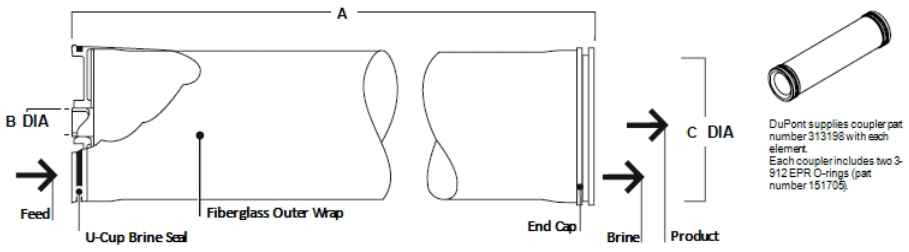
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30XFR-400/34	400	37	34-LDP	11,500	43	99.65	99.4

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 225 psi (15.5 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than ± 15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
BW30XFR-400/34	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

Product Stewardship

DuPont has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with DuPont products—from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

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Please be aware of the following:

- 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.

Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW30XFR-400/34i

BW30XFR-400/34i

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque reflue e di una certa criticità che desiderano comuque ottenere elevate prestazioni, lunga durata dei moduli, alte produzioni e quaità uniti ad un' eccellente rsistenza agli sporcamenti.

FilmTec™ BW30XFR-400/34 offre prestazioni comprovate come:

- Alta qualità del permeato con abbattimento dei costi CAPEX e OPEX
- Offrire una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, iltutto supportato dal servizio tecnico Hytek e DuPont
- Tappi terminali con sistema interlock iLEC ™, che riducono i costi operativi del sistema e il rischio di perdite dagli o-ring che possono esser causa di scarsa qualità dell'acqua

BW30XFR-400/34i

Ideal for: reverse osmosis plant managers and operators dealing with challenging waters and wastewaters and seeking consistent high performance, long element life, increased productivity and higher water quality coupled with excellent fouling resistance.

With proven performance, FilmTec™ BW30XFR-400/34:

- Delivers the highest quality permeate water while minimizing CAPEX and OPEX
- Offers the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1 – 13) and chemical tolerance, and the support of DuPont representatives
- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

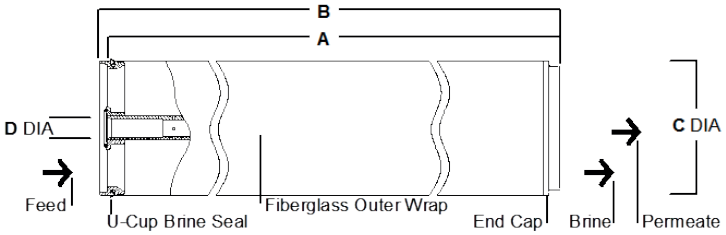
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30XFR-400/34i	400	37	34-LDP	11,500	43	99.65	99.4

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 225 psi (15.5 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than ± 15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
BW30XFR-400/34i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en). 1 inch = 25.4 mm
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

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- Start-Up Sequence (Form No. 45-D01609-en)

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Regulatory Note

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FilmTec™ BW30XFRLE-400/34

BW30XFRLE-400/34

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque reflue e di una certa criticità che desiderano comuque ottenere buona qualità del permeato, eccellente rsistenza agli sporcamenti bassa pressione.

FilmTec™ BW30XFRLE-400/34:

- Offre una buona reiezione salina con un 30% di pressione in meno
- Offre un' eccellente reiezione su silice, nitrati e ammonio
- Offrire una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, iltutto supportato dal servizio tecnico Hytek e DuPont

BW30XFRLE-400/34

Ideal for: reverse osmosis plant managers and operators dealing with challenging waters and wastewaters who are seeking an advanced membrane treatment with good water purity, improved fouling resistance and low energy consumption.

FilmTec™ BW30XFRLE-400/34:

- Offers good salt-rejection with 30% lower pressures
- Delivers excellent silica, nitrate and ammonium rejection
- Provides the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives

Product Type

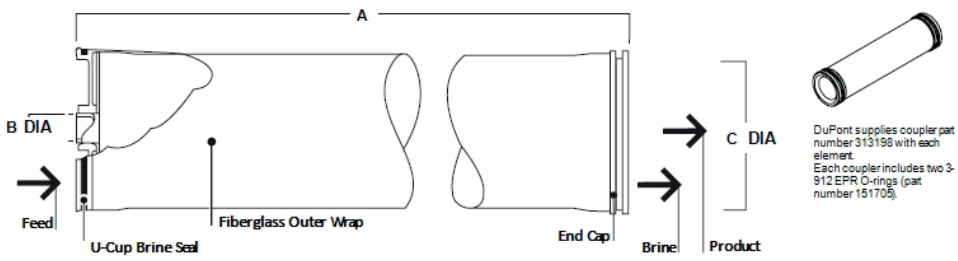
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30XFRLE-400/34	400	37	34-LDP	11,500	43	99.3	99.1

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 150 psi (10.3 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than +15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
BW30XFRLE-400/34	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

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Please be aware of the following:

- 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.

Regulatory Note

These products may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW30XFRLE-400/34i

BW30XFRLE-400/34i

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque reflue e di una certa criticità che desiderano comuque ottenere buona qualità del permeato, eccellente rsistenza agli sporcamenti bassa pressione.
FilmTec™ BW30XFRLE-400/34:

- Offre una buona reiezione salina con un 30% di pressione in meno
- Offre un' eccellente reiezione su silice, nitrati e ammonio
- Offrire una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, iltutto supportato dal servizio tecnico Hytek e DuPont
- Tappi terminali con sistema interlock iLEC ™, che riducono i costi operativi del sistema e il rischio di perdite dagli o-ring che possono esser causa di scarsa qualità dell'acqua

BW30XFRLE-400/34i

Ideal for: reverse osmosis plant managers and operators dealing with challenging waters and wastewaters who are seeking an advanced membrane treatment with good water purity, improved fouling resistance and low energy consumption.
FilmTec™ BW30XFRLE-400/34:

- Offers good salt-rejection with 30% lower pressures
- Delivers excellent silica, nitrate and ammonium rejection
- Provides the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives
- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

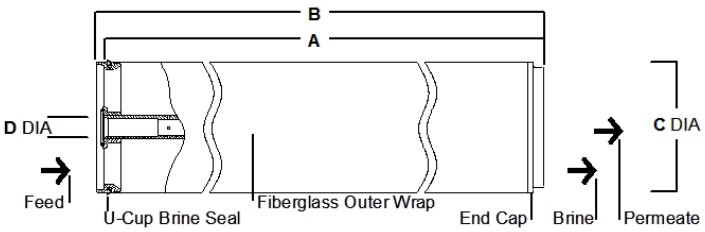
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

	Active Area		Feed Spacer Thickness (mil)	Permeate Flow Rate		Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
FilmTec™ Element	(ft^2)	(m^2)		(GPD)	(m^3/d)		
BW30XFRLE-400/34i	400	37	34-LDP	11,500	43	99.3	99.1

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 150 psi (10.3 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than ± 15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
BW30XFRLE-400/34i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

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- Start-Up Sequence (Form No. 45-D01609-en)

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Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW30HR-440

BW30HR-440

Il modulo FilmTec ™ BW30HR-440 è l'ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque con sistema di pre trattamento ottimizzato e vogliono ottenere: elevate prestazioni, lunga durata, alta produzione e qualità associate ad un'eccezionale resistenza allo sporcamento. I moduli BW30HR-440 riducono l' ingombro delle installazioni. FilmTec ™ BW30HR-440 offre prestazioni comprovate come:

• Fornire un permeato di alta qualità riducendo al minimo sia i costi in Conto Capitale(CAPEX) che quelli di Gestione (OPEX).

• Offrire una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, iltutto supportato dal servizio tecnico Hytek e DuPont

BW30HR-440

FilmTec™ BW30HR-440 Element is ideal for: reverse osmosis plant managers and operators dealing with controlled pre-treatment waters and seeking consistency, high performance, long element life, increase productivity, higher water quality coupled with outstanding fouling resistance and reduced footprint installations.

With proven performance, FilmTec™ BW30HR-440:

• Delivers high quality permeate water while minimizing CAPEX and OPEX

• Offers increased active area with highly effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives

Product Type

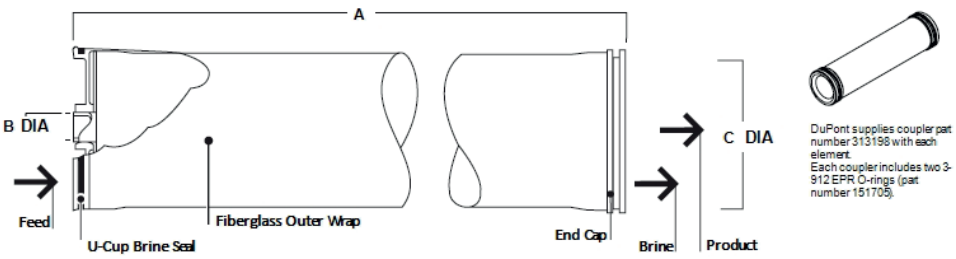
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30HR-440	440	41	28	12,650	48	99.7	99.4

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 225 psi (15.5 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than ± 15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
BW30HR-440	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

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Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW30HR-440i

BW30HR-440i

Il modulo FilmTec ™ BW30HR-440i è l'ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque con sistema di pre trattamento ottimizzato e vogliono ottenere: elevate prestazioni, lunga durata, alta produzione e qualità associate ad un'eccezionale resistenza allo sporcamento. I moduli BW30HR-440i riducono l' ingombro delle installazioni. FilmTec ™ BW30HR-440i offre prestazioni comprovate come:

- Fornire un permeato di alta qualità riducendo al minimo sia i costi in Conto Capitale(CAPEX) che quelli di Gestione (OPEX).
- Offrire una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, il tutto supportato dal servizio tecnico Hytek e DuPont
- Tappi terminali con sistema interlock iLEC ™, che riducono i costi operativi del sistema e il rischio di perdite dagli o-ring che possono esser causa di scarsa qualità dell'acqua

BW30HR-440i

FilmTec™ BW30HR-440i Element is ideal for: reverse osmosis plant managers and operators dealing with controlled pre-treatment waters and seeking consistency, high performance, long element life, increase productivity, higher water quality coupled with outstanding fouling resistance and reduced footprint installations.

With proven performance, FilmTec™ BW30HR-440i:

- Delivers high quality permeate water while minimizing CAPEX and OPEX
- Offers increased active area with highly effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives
- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

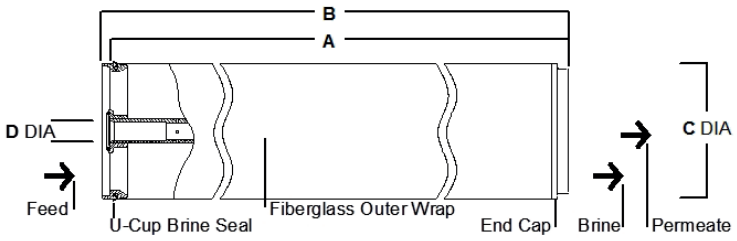
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30HR-440i	440	41	28	12,650	48	99.7	99.4

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 225 psi (15.5 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than ± 15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	**(in.)**	**(mm)**	**(in.)**	**(mm)**	**(in.)**	**(mm)**	**(in.)**	**(mm)**
BW30HR-440i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

Product Stewardship

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Please be aware of the following:

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Regulatory Note

This product may be subject to drinking water application restrictions in some countries; please check the application status before use and sale.

FilmTec™ BW30HRLE-440

BW30HRLE-440

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque con sistema di pre trattamento ottimizzato e ambizioni di risultati qualitativi quali: buona qualità dell'acqua utilizzando basse pressioni.

FilmTec ™ BW30HRLE-440:

- Offre una buona reiezione salina con pressioni ridotte del 33%
- Offre un' eccellente reiezione su silice, boro, nitrati, IPA e ammonio
- Offre una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, il tutto supportato dal servizio tecnico Hytek e DuPont

BW30HRLE-440

Ideal for: reverse osmosis plant managers and operators dealing with controlled-pre-treatment waters and seeking advanced membrane treatment with good water purity and low energy consumption.

FilmTec™ BW30HRLE-440:

- Offers good salt-rejection with 33% lower pressures
- Delivers excellent silica, boron, nitrate, IPA and ammonium rejection
- Provides increased active area with the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives

Product Type

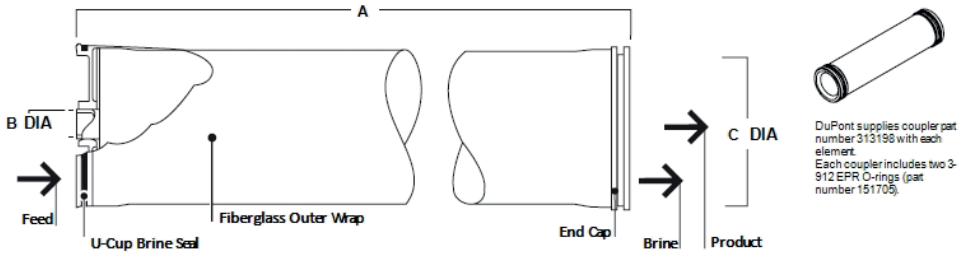
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30HRLE-440	440	41	28	12,650	48	99.3	99.1

a. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 150 psi (10.3 bar), 77°F (25°C), pH 8, 15% recovery.
b. Flow rates for individual elements may vary but will be no more than ± 15%.
c. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
d. Sales specifications may vary as design revisions take place.
e. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
BW30HRLE-440	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to described in Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

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FilmTec™ BW30HRLE-440i

BW30HRLE-440i

deale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque con sistema di pre trattamento ottimizzato e ambizioni di risultati qualitativi quali: buona qualità dell'acqua utilizzando basse pressioni.

FilmTec™ BW30HRLE-440i:

- Offre una buona reiezione salina con pressioni ridotte del 33%
- Offre un' eccellente reiezione su silice, boro, nitrati, IPA e ammonio
- Offre una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, il tutto supportato dal servizio tecnico Hytek e DuPont
- Tappi terminali con sistema interlock iLEC ™, che riducono i costi operativi del sistema e il rischio di perdite dagli o-ring che possono esser causa di scarsa qualità dell'acqua

BW30HRLE-440i

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FilmTec™ BW30HRLE-440i:

- Offers good salt-rejection with 33% lower pressures
- Delivers excellent silica, boron, nitrate, IPA and ammonium rejection
- Provides increased active area with the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives
- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

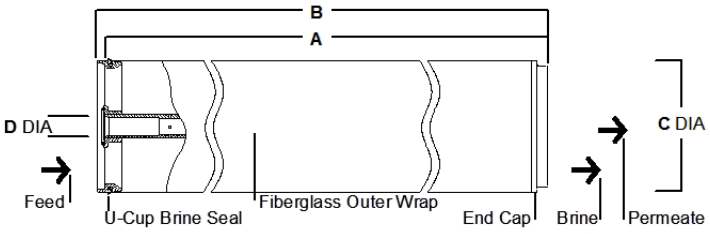
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
BW30HRLE-440i	440	41	28	12,650	48	99.3	99.1

a. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 150 psi (10.3 bar), 77°F (25°C), pH 8, 15% recovery.
b. Flow rates for individual elements may vary but will be no more than ± 15%.
c. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
d. Sales specifications may vary as design revisions take place.
e. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



FilmTec™ Element	A (in.)	A (mm)	B (in.)	B (mm)	C (in.)	C (mm)	D (in.)	D (mm)
BW30HRLE-440i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

Dimensions – inches (mm) — 1 inch = 25.4 mm

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to described in Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

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FilmTec™ Eco Pro-400

Eco Pro-400

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque di una certa criticità e che ricercano una soluzione per affrontare le difficili sfide di CAPEX e OPEX.
FilmTec ™ Eco Pro-400:

- Offre alta reiezione di sale a bassa pressione
- Riduce l'impatto del fouling riducendo al minimo le perdite di carico
- Offre un' eccellente reiezione su silice, boro, nitrati, TOC e ammonio
- Offre una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, il tutto supportato dal servizio tecnico Hytek e DuPont

Eco Pro-400

Ideal for: reverse osmosis plant managers and operators dealing with challenging waters who are looking for a state-of-the-art solution to tackle tough CAPEX and OPEX challenges.
FilmTec™ Eco Pro-400:

- Offers high salt-rejection at low pressure
- Achieves reduction of the fouling impact by minimized pressure drop
- Delivers excellent silica, boron, nitrate, TOC and ammonium rejection
- Provides most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives

Product Type

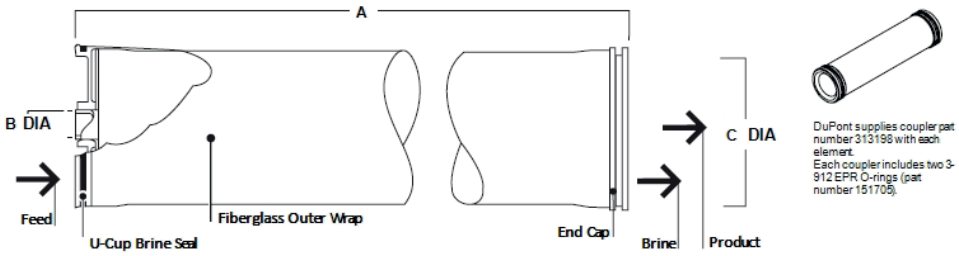
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
Eco Pro-400	400	37	34-LDP	11,500	43	99.7	99.4

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 150 psi (10.3 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than +15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ±3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
Eco Pro-400	40.0	1,016	125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en)
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

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- Riduce l'impatto del fouling riducendo al minimo le perdite di carico
- Offre un' eccellente reiezione su silice, boro, nitrati, TOC e ammonio
- Offre una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, il tutto supportato dal servizio tecnico Hytek e DuPont
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- Achieves reduction of the fouling impact by minimized pressure drop
- Delivers excellent silica, boron, nitrate, TOC and ammonium rejection
- Provides most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives
- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
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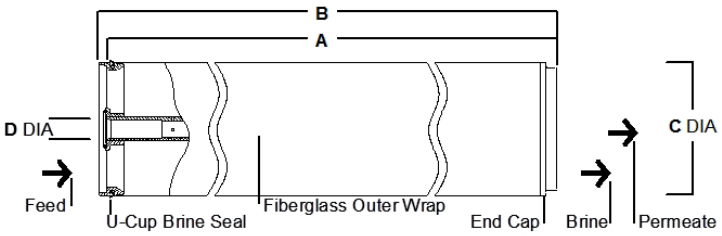
Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
Eco Pro-400i	40.0	1,016	40.51.	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en)
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

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Regulatory Note

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FilmTec™ Eco Pro-440

Eco Pro-440

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque con sistema di pre trattamento ottimizzato e ambizioni di risultati qualitativi quali: buona qualità dell'acqua utilizzando basse pressioni.

FilmTec™ Eco Pro-440:

- Offre un' alta reiezione salina con basse pressioni
- Offre un' eccellente reiezione su silice, boro, nitrati, TOC e ammonio
- Offre una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, il tutto supportato dal servizio tecnico Hytek e DuPont

Eco Pro-440

Ideal for: reverse osmosis plant managers and operators dealing with controlled pre-treatment waters and seeking advanced membrane treatment with high water purity and low energy consumption.

FilmTec™ Eco Pro-440:

- Offers high salt-rejection at low pressure
- Delivers excellent silica, boron, nitrate, TOC and ammonium rejection
- Provides increased active area with the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives

Product Type

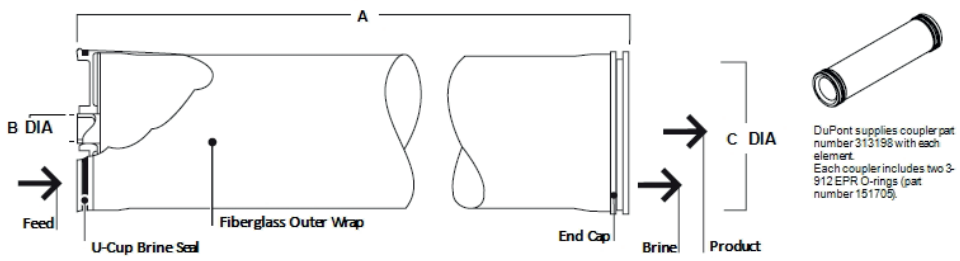
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
Eco Pro-440	440	41	28	12,650	48	99.7	99.4

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 150 psi (10.3 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than +15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ±3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
Eco Pro-440	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

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FilmTec™ Eco Pro-440i

Eco Pro-440i

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FilmTec™ Eco Pro-440i:

- Offre un' alta reiezione salina con basse pressioni
- Offre un' eccellente reiezione su silice, boro, nitrati, TOC e ammonio
- Offre una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, il tutto supportato dal servizio tecnico Hytek e DuPont
- Tappi terminali con sistema interlock iLEC ™, che riducono i costi operativi del sistema e il rischio di perdite dagli o-ring che possono esser causa di scarsa qualità dell'acqua

Eco Pro-440i

Ideal for: reverse osmosis plant managers and operators dealing with controlled pre-treatment waters and seeking advanced membrane treatment with high water purity and low energy consumption.

FilmTec™ Eco Pro-440i:

- Offers high salt-rejection at low pressure
- Delivers excellent silica, boron, nitrate, TOC and ammonium rejection
- Provides increased active area with the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives
- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

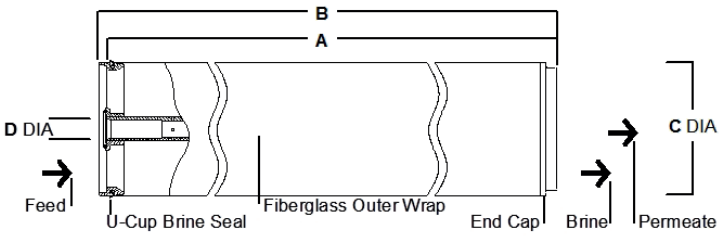
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
Eco Pro-440i	440	41	28	12,650	48	99.7	99.4

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 150 psi (10.3 bar), 77°F (25°C), pH 8, 15% recovery.
2. Flow rates for individual elements may vary but will be no more than +15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
Eco Pro-440i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

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FilmTec™ Eco Platinum-440

Eco Platinum-440

Ideale per: gestori e venditori d' impianti ad osmosi inversa che operano su acque di una certa criticità e che ricercano una soluzione per affrontare le difficili sfide di CAPEX e OPEX.
FilmTec ™ Eco Platinum-440:

- E' la membrana industriale più performante della gamma Flmtec ™ grazie ad un combinato tra produzione a bassa pressione e alta reiezione salina
- Fornisce un flusso equilibrato che consenteun risparmio generale su tutto il sistema
- Offre un' eccellente reiezione su silice, boro, nitrati, TOC e ammonio
- Offre una maggiore area filtrante unita ad alte prestazioni di lavaggio, robustezza, lunga durabilità grazie all' ampio range di pH di lavaggio (1-13) con conseguente superiore tolleranza chimica, il tutto supportato dal servizio tecnico Hytek e DuPont

Eco Platinum-440

Ideal for: reverse osmosis plant managers and operators dealing with controlled pre-treatment waters who are looking for a state-of-the-art solution to tackle tough CAPEX and OPEX challenges.
FilmTec™ Eco Platinum-440:

- Offers all of FilmTec™ Elements' industry-leading benefits coupled with a unique combination of low energy and high salt rejection
- Provides improved hydraulic balance which enables system energy savings
- Delivers excellent silica, boron, nitrate, TOC and ammonium rejection
- Provides increased active area with the most effective cleaning performance, robustness and durability due to its widest cleaning pH range (1-13) and chemical tolerance and the support of DuPont technical representatives.

Product Type

Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
Eco Platinum-440	440	41	28-LDP	12,650	48	99.7	99.4

1. Permeate flow and salt (NaCl) rejection based on the following standard test conditions: 2,000 ppm NaCl, 150 psi (10.3 bar), 77°F (25°C), pH 8, 15% recovery.
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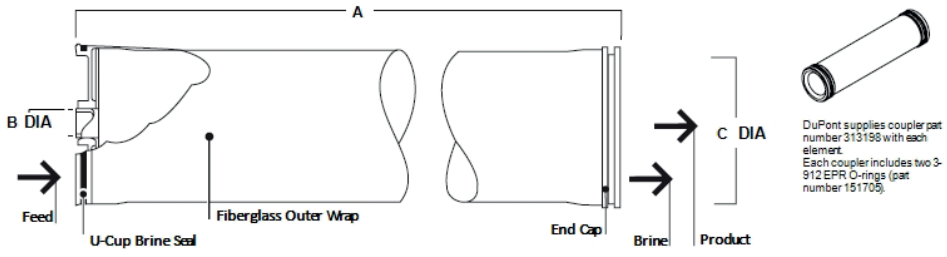

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	A		B		C	
FilmTec™ Element	**(in.)**	**(mm)**	**(in.)**	**(mm)**	**(in.)**	**(mm)**
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pH Range	
Continuous Operation [a]	2 – 11
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Maximum Feed Silt Density Index (SDI)	SDI 5
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FilmTec™ Eco Platinum-440i

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- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
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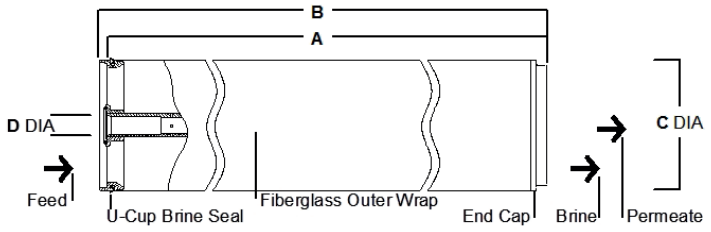

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	A		B		C		D	
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Eco Platinum-440i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

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Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

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MEMBRANE SW FILMTEC PER ACQUA DI MARE PER PICCOLE E MEDIE APPLICAZIONI / FILMTEC SW EMBRANES FOR SEA WATER FOR SMALL AND MEDIUM APPLICATIONS

SW **SW**

CARATTERISTICHE GENERALI:
Le membrane FILMTEC per acque di mare, hanno la caratteristica di avere la più alta produttività con un' eccellente reiezione.
• Le membrane FILMTEC SW30 offrono la maggior produzione possibile per impianti RO per acqua di mare sia per aplicazioni di terra che su imbarcazioni o piattaforme.
• Le membrane FILMTEC SW30 possono operare anche a pressioni più basse per comprimere i costi delle pompe e quelli generali.
• L' altissimo standard produttivo delle membrane acqua mare FILMTEC ha portato le SW30 a performance eccellenti e comprovate, disponibili per tutte le esigenze progettuali.

LIMITI E CARATTERISTICHE OPERATIVE:
- Materiale membrana: _____ Polyamide Thin-Film Composite
- Temperatura massima di esercizio: _____ 113°F (45°C)
- Pressione massima di esercizio:_____ 1000 psig (69 bar)
- Perdita di carico massima: _____ 15 psig (1,0 bar)
- pH Range in continuo : _____ 2 fi 11
- pH Range limitato per lavaggio (30 min.): _____ 1 fi 12
- SDI massimo: _____ 5
- Tolleranza al cloro libero: _____ <0.1 ppm

CERTIFICAZIONI
- FDA CFR 21 177-2550

APPLICAZIONI:
- Piccoli e medi impianti RO per acqua di mare
- Piccoli e medi impianti RO per ibarcazioni da diporto

INFORMAZIONI GENERALI
- La prima acqua permeata dovrebbe essere scartata. Non utilizzare la prima acqua prodotta per preparare cibi o bevande.
- Tenere le membrane umide dopo la prima bagnatura.
- Se i limti del presente bollettino non vengono osservati scrupolosamente, la garanzia decade.
- Si raccomanda in caso di fermo macchina RO, la conservazione delle membrane tramite prodotto anti-batterico per evitare la formazione di materiale biologico.
- La membrana è resistente per un breve periodo al contatto con cloro (ipoclorito). Il contatto prolungato e superiore agli 0,1 ppm potrebbe danneggiare irreversibilmente la membrana.
- Il cliente è interamente responsabile per l' utilizzo di prodotti chimici di lavaggio ed eventuali lubrificanti incompatibili con la membrana. Tale responsabilità limiterà o annullera la garanzia.
- La massima perdita di carico consentita tra ingresso ed uscita di un vessel è di 3.4 bar (50 psi).
- Evitare sempre contro pressioni statiche sul tubo del permeato.

GUIDA OPERATIVA:
Evitare brusche variazioni di pressione e di flussi al momento della messa in funzione, dello spegnimento sospensione dell'attività, pulizia dell' impianto ecc, per non danneggiare la membrana osmostica. Tra una fermata e una messa in funzione dell' impianto, raccomandiamo che:
• la pressione di alimento deve aumentare gradualmente ed arrivare a pieno regime nel giro di 30-60 secondi.
• la produzione deve aumentare gradualmente ed arrivare a pieno regime non prima dei 15-20 secondi.
• Il permeato ottennuto nella prima ora di funzionamento dell' impianto, dovrebbe essere scartato.

GENERAL FEATURES:
Improved FILMTEC seawater reverse osmosis elements offer the highest productivity while maintaining excellent salt rejection.
• FILMTEC SW30 membrane elements have the highest flow rates available to meet the water demands of both sea-based and land-based desalinators.
• FILMTEC SW30 elements may also be operated at lower pressure to reduce pump size, cost and operating expenses.
• Improved FILMTEC seawater membrane combined with automated, precision element fabrication result in the most consistent product performance available.

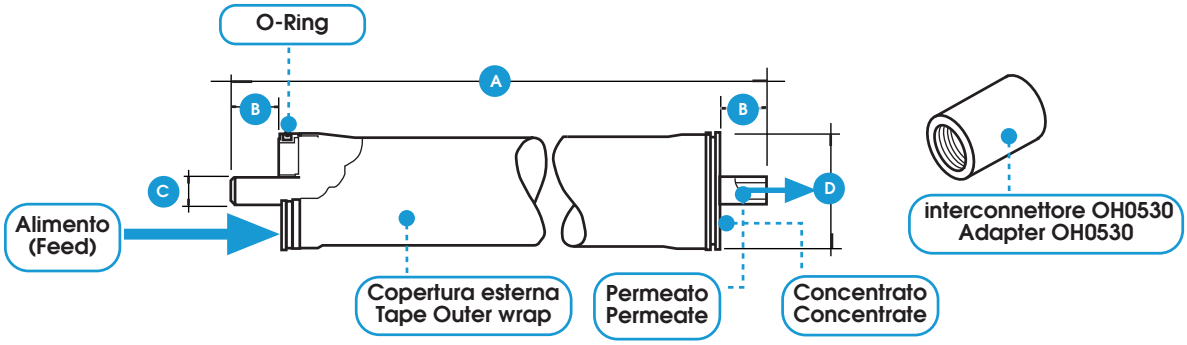
OPERATING LIMITS FEATURES:
- Membrane Type: _____ Polyamide Thin-Film Composite
- Maximum Operating Temperature: _____ 113°F (45°C)
- Maximum Operating Pressure: _____ 1000 psig (69 bar)
- Maximum Pressure Drop: _____ 15 psig (1,0 bar)
- pH Range, Continuous Operation: _____ 2 fi 11
- pH Range, Short-Term Cleaning (30 min.): _____ 1 fi 12
- Maximum Feed Silt Density Index (SDI): _____ 5
- Free Chlorine Tolerance: _____ <0.1 ppm

CERTIFICATIONS:
- FDA CFR 21 177-2550

APPLICATIONS:
- Small and medium RO sistem for sea water
- Small and medium RO sistem for pleasure ship

GENERAL INFORMATION:
- The first full tank of permeate should be discarded. Do not use this initial permeate for drinking water or food preparation.
- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements. Their use will void the element limited warranty.
- Maximum pressure drop across an entire pressure vessel (housing) is 50 psi (3.4 bar).
- Avoid static permeate-side backpressure at all times.

OPERATION GUIDELINES:
Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a stand still to operating state is recommended as follows:
• Feed pressure should be increased gradually over a 30-60 second time frame.
• Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.
• Permeate obtained from first hour of operation should be discarded.



Dimensioni / Dimensions

Prodotto Product	Portata Massima in Allimento gpm (m3/h) Maximum Feed Flow Rate gpm (m3/h)	A inch (mm)	B inch (mm)	C inch (mm)	D inch (mm)
SW30-2514	6 (1.4)	14.0 (356)	1.19 (30.2)	0.75 (19)	2.4 (61)
SW30-2521	6 (1.4)	21.0 (533)	1.19 (30.2)	0.75 (19)	2.4 (61)
SW30-2540	6 (1.4)	40.0 (1,016)	1.19 (30.2)	0.75 (19)	2.4 (61)
SW30-4021	16 (3.6)	21.0 (533)	1.05 (26.7)	0.75 (19)	3.9 (99)
SW30-4040	16 (3.6)	40.0 (1,016)	1.05 (26.7)	0.75 (19)	3.9 (99)
SW30HR LE-4040	16 (3.6)	40.0 (1,016)	1.05 (26.7)	0.75 (19)	3.9 (99)

1 inch = 25.4 mm

Specifiche del prodotto / Product Specifications

Modello Model	Area filtrante ft^2 (m^2) Active area ft^2 (m^2)	Pressione applicata psig (bar) Applied Pressure psig (bar)	Produzione Permeato gpd (m3/g) Permeate Flow Rate gpd (m3/g)	Reiezione Stabilizzata (%) Stabilized Salt Rejection (%)
SW30-2514	6.5 (0.6)	800 (55)	150 (0.6)	99.4
SW30-2521	13 (1.2)	800 (55)	300 (1.1)	99.4
SW30-2540	29 (2.8)	800 (55)	700 (2.6)	99.4
SW30-4021	33 (3.1)	800 (55)	800 (3.0)	99.4
SW30-4040	80 (7.4)	800 (55)	1,950 (7.4)	99.4
SW30HR LE-4040	85 (7.9)	800 (55)	1,600 (6.1)	99.75

1. Il flusso di permeato e la reiezione salina sono basati alle seguenti condizioni di test: 32.000 ppm NaCl, alla pressione specificata sopra, 77°F (25°C), e ai seguenti recuperi: SW30-2514 – 2%, SW30-2521 & SW30-4021 – 4%, SW30-2540 & SW30-4040 – 8%, SW30HR LE-4040 – 8%
Permeate flow and salt rejection based on the following test conditions: 32,000 ppm NaCl, pressure specified above, 77°F (25°C) and the following recovery rates: SW30-2514 – 2%, SW30-2521 & SW30-4021 – 4%, SW30-2540 & SW30-4040 – 8%, SW30HR LE-4040 – 8%.
2. La produzione del permeato può variare da membrana a membrana del +/-20%.
Permeate flows for individual elements may vary +/-20%.
3. Per motivi di miglioramento del prodotto, i dati possono subire delle modifiche periodiche
For the purpose of improvement, specifications may be updated periodically.

FilmTec™ SW30HR-380

SW30HR-380

CARATTERISTICHE GENERALI:
La FILMTEC SW30HR-380 è una membrana per acqua di mare prodota con un alto standard produttivo, con grande superficie filtrante e un' alta reiezione salina per poter garantire prestazioni ed economicità dei sistemi RO per acqua di mare.
• FILMTEC SW30HR-380 ha la più alta reiezione nei confronti del boro, rientrando nel parametro limite stabilito dall' Organizzazione Mondiale della Salute e da altri Standard mondiali.
• FILMTEC SW30HR-380 assicurano una durata nel tempo maggiore dei prodotti concorrenti, in quanto non necessitano di post trattamenti ossidativi. Questa condizione è una delle ragioni percui la SW30HR-380 è più durevole nel tempo e può così essere lavata in un range di pH più ampio delle altre membrane.
• L' alto standard produttivo raggiunto, ha permesso di realizzare un numero di fogli semipermeabli con lunghezza inferiore alle membrane standard, aumentando le performance complessive.

LIMITI E CARATTERISTICHE OPERATIVE:
- Materiale membrana: _____ Polyamide Thin-Film Composite
- Temperatura massima di esercizio: _____ 113°F (45°C)
- Pressione massima di esercizio:_____ 1000 psig (69 bar)
- Perdita di carico massima: _____ 15 psig (1,0 bar)
- pH Range in continuo : _____ 2 fi 11
- pH Range limitato per lavaggio (30 min.): _____ 1 fi 12
- SDI massimo: _____ 5
- Tolleranza al cloro libero: _____ <0.1 ppm

CERTIFICAZIONI
- FDA CFR 21 177-2550
- KIWA - ATA

APPLICAZIONI:
- Sistemi RO con grandi portate e alta reiezione salina

INFORMAZIONI GENERALI
- La prima acqua permeata dovrebbe essere scartata. Non utilizzare la prima acqua prodotta per preparare cibi o bevande.
- Tenere le membrane umide dopo la prima bagnatura.
- Se i limti del presente bollettino non vengono osservati scrupolosamente, la garanzia decade.
- Si raccomanda in caso di fermo macchina RO, la conservazione delle membrane tramite prodotto anti-batterico per evitare la formazione di materiale biologico.
- La membrana è resistente per un breve periodo al contatto con cloro (ipoclorito). Il contatto prolungato e superiore agli 0,1 ppm potrebbe danneggiare irreversibilmente la membrana.
- Il cliente è interamente responsabile per l' utilizzo di prodotti chimici di lavaggio ed eventuali lubrificanti incompatibili con la membrana. Tale responsabilità limiterà o annullera la garanzia.
- La massima perdita di carico consentita tra ingresso ed uscita di un vessel è di 3.4 bar (50 psi).
- Evitare sempre contro pressioni statiche sul tubo del permeato.

GUIDA OPERATIVA:
Evitare brusche variazioni di pressione e di flussi al momento della messa in funzione, dello spegnimento sospensione dell'attività, pulizia dell' impianto ecc, per non danneggiare la membrana osmostica. Tra una fermata e una messa in funzione dell' impianto, raccomandiamo che:
• la pressione di alimento deve aumentare gradualmente ed arrivare a pieno regime nel giro di 30-60 secondi.
• la produzione deve aumentare gradualmente ed arrivare a pieno regime non prima dei 15-20 secondi.
• Il permeato ottennuto nella prima ora di funzionamento dell' impianto, dovrebbe essere scartato.

SW30HR-380

GENERAL FEATURES:
The FILMTEC SW30HR-380 is a premium grade seawater reverse osmosis element featuring both high active area and high salt rejection to offer the best long-term economics for seawater desalination systems.
• FILMTEC SW30HR-380 delivers the highest boron rejection to help customers meet World Health Organization (WHO) and other drinking water standards.
• FILMTEC SW30HR-380 elements deliver high performance over their operating lifetime without the use of oxidative post-treatments like many competitive products. This is one reason why FILMTEC elements are more durable and may be cleaned more effectively over a wide pH range than other RO elements.
• Automated, precision fabrication with a greater number of shorter membrane leaves, reduces the overall effect of fouling and maximizes membrane efficiency.

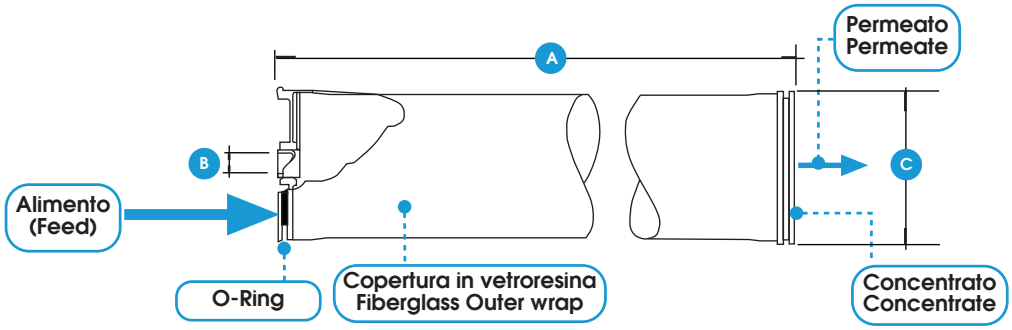
OPERATING LIMITS FEATURES:
- Membrane Type: _____ Polyamide Thin-Film Composite
- Maximum Operating Temperature: _____ 113°F (45°C)
- Maximum Operating Pressure: _____ 1000 psig (69 bar)
- Maximum Pressure Drop: _____ 15 psig (1,0 bar)
- pH Range, Continuous Operation: _____ 2 fi 11
- pH Range, Short-Term Cleaning (30 min.): _____ 1 fi 12
- Maximum Feed Silt Density Index (SDI): _____ 5
- Free Chlorine Tolerance: _____ <0.1 ppm

CERTIFICATIONS:
- FDA CFR 21 177-2550
- KIWA - ATA

APPLICATIONS:
- Big RO sistem for sea water with high rejection

GENERAL INFORMATION:
- The first full tank of permeate should be discarded. Do not use this initial permeate for drinking water or food preparation.
- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements. Their use will void the element limited warranty.
- Maximum pressure drop across an entire pressure vessel (housing) is 50 psi (3.4 bar).
- Avoid static permeate-side backpressure at all times.

OPERATION GUIDELINES:
Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a stand still to operating state is recommended as follows:
• Feed pressure should be increased gradually over a 30-60 second time frame.
• Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.
• Permeate obtained from first hour of operation should be discarded.



Dimensioni / Dimensions

Prodotto Product	Recupero massimo per singolo elemento (Permeato/Alimento) Single-Element Recovery (Permeate Flow to Feed Flow)	A inch (mm)	B inch (mm)	C inch (mm)
SW30HR-380	8%	40.0 (1,016)	1.125 (29)	7.9 (201)

1 inch = 25.4 mm

Specifiche del prodotto / Product Specifications

Modello Model	Area filtrante ft^2 (m^2) Active area ft^2 (m^2)	Pressione applicata psig (bar) Applied Pressure psig (bar)	Produzione Permeato gpd (m3/d) Permeate Flow Rate gpd (m3/d)	Reiezione Stabilizzata Cl^- (%) Stabilized Salt Rejection Cl^- (%)
SW30HR-380	380 (35)	800 (55)	6,000 (23)	99.7

1. Produzione Permeato e reiezione salina basati sulle seguenti condizioni di test: 77°F (25°C), recupero del 8%, 800 psi (55 bar), pH 8, testate a con acqua a 32.000 ppm di NaCl.
Permeate flow and salt rejection based on the following test conditions: 77°F (25°C), 8% recovery, pressure 800 psi (55 bar), pH 8, test with water at 32,000 ppm NaCl.
2. La produzione del permeato può variare da membrana a membrana del +/- 15%
Flow rates for individual elements may +/- 15%.
3. Minima reiezione salina per elemento del 99.6%.
Minimum salt rejection for individual elements is 99.6%.
4. Per motivi di miglioramento del prodotto, i dati possono subire delle modifiche periodiche
For the purpose of improvement, specifications may be updated periodically.
5. Lo spaziatore è da 34 mil
Feed spacer is 34 mil

FilmTec™ SW30HRLE-400

FilmTec™ SW30HRLE-400 Element

Seawater Reverse Osmosis Element

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements designed to reduce capital and operation cost of seawater RO systems. FilmTec™ Elements combine premium membrane performance with automated precision fabrication which takes system performance to exceptional levels.

FilmTec™ SW30HRLE-400 Elements offer a combination of high rejection and low energy requirements to allow lower total costs with medium- and high-salinity feedwater. Benefits of the FilmTec™ SW30HRLE-400 Element include:

- Helps systems to be designed and operated to optimize operating cost through lower energy consumption or to optimize capital cost through higher productivity at lower operating fluxes.
- High NaCl and boron rejection to help meet World Health Organization (WHO) and other drinking water standards.
- Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.
- High performance over the operating lifetime without the use of oxidative posttreatments. This is one reason FilmTec™ Elements are more durable and may be cleaned more effectively over a wider pH range (1 – 13) than other RO elements.
- Automated, precision fabrication with a greater number of shorter membrane leaves reducing the effect of overall fouling and maximizing element efficiency, helping to lower your cost of operation.

Product Type

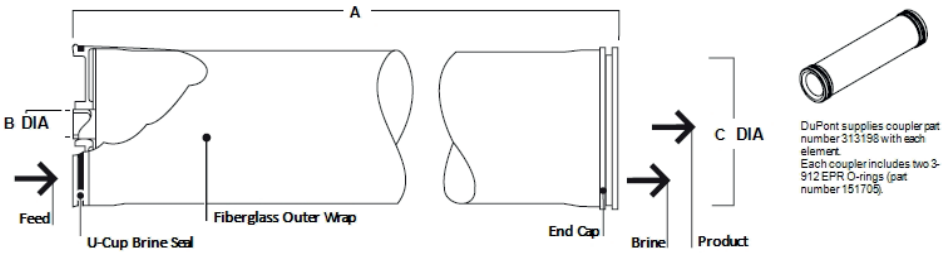
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30HRLE-400	400	37	28	7,500	28	92	99.80

1. The above values are normalized to the following conditions: 32,000 ppm NaCl, 5 ppm boron, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ± 15%.
3. Minimum Salt Rejection is 99.65%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ± 5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30HRLE-400	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to technical bulletin Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
- Storage and Shipping of New FilmTec™ Elements (Form No. 45-D01633-en)

Product Stewardship

DuPont has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with DuPont products—from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

DuPont strongly encourages its customers to review both their manufacturing processes and their applications of DuPont products from the standpoint of human health and environmental quality to ensure that DuPont products are not used in ways for which they are not intended or tested. DuPont personnel are available to answer your questions and to provide reasonable technical support. DuPont product literature, including safety data sheets, should be consulted prior to use of DuPont products. Current safety data sheets are available from DuPont.

Please be aware of the following:

- 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.

FilmTec™ SW30HRLE-440

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements designed to help reduce capital and operation cost of desalination systems. FilmTec™ Elements combine excellent membrane quality with automated precision fabrication, taking system performance to exceptional levels.

FilmTec™ SW30HRLE-440 Elements offer sustainable lower life-cycle cost for medium- and high-salinity feedwater by combining high rejection and low energy performance with the highest active area and a thick feed spacer. Benefits of the FilmTec™ SW30HRLE-440 Element include:

- Helps systems to be designed and operated to either lower operating cost through reduced energy consumption, or to decrease capital cost through higher productivity at lower operating fluxes.
- High NaCl and boron rejection to help meet World Health Organization (WHO) and other drinking water standards.
- Very high guaranteed active area of 440 ft^2 (41 m^2) permits lower system cost by maximizing productivity and facilitating accurate and predictable system design and operating flux.
- The combination of very high active area with a thick feed spacer (28 mil) allows low cleaning frequency and high cleaning efficiency.
- Sustainable high performance over the operating lifetime of the element, because oxidative treatments are not used in membrane production. This is one reason FilmTec™ Elements are more durable and may be cleaned more effectively over a wider pH range (1 – 13) than most other RO elements, which use oxidative treatments.
- Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.

Product Type

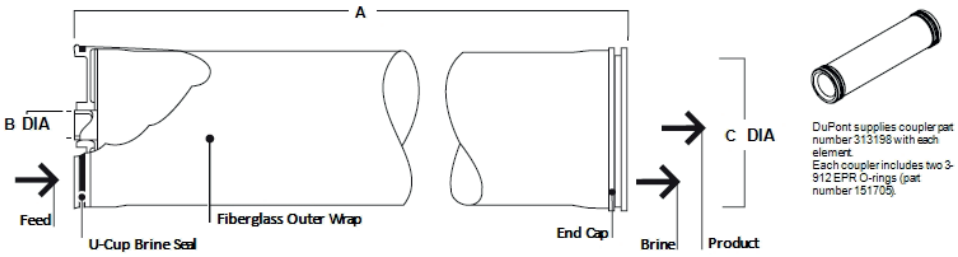
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30HRLE-440	440	41	28	8,000	30.2	92	99.80

1. The above values are normalized to the following conditions: 32,000 ppm NaCl, 5 ppm boron, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ± 15%.
3. Minimum Salt Rejection is 99.65%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ± 5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)					1 inch = 25.4 mm	
	A		B		C	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30HRLE-440	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
- Storage and Shipping of New FilmTec™ Elements (Form No. 45-D01633-en)

Product Stewardship

DuPont has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with DuPont products—from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

DuPont strongly encourages its customers to review both their manufacturing processes and their applications of DuPont products from the standpoint of human health and environmental quality to ensure that DuPont products are not used in ways for which they are not intended or tested. DuPont personnel are available to answer your questions and to provide reasonable technical support. DuPont product literature, including safety data sheets, should be consulted prior to use of DuPont products. Current safety data sheets are available from DuPont.

Please be aware of the following:

- 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.

FilmTec™ SW30HRLE-440i

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements designed to help reduce capital and operation cost of desalination systems. FilmTec™ Elements combine excellent membrane quality with automated precision fabrication, taking system performance to exceptional levels.

FilmTec™ SW30HRLE-440i Elements offer sustainable lower life-cycle cost for medium- and high-salinity feedwater by combining high rejection and low energy performance with the highest active area and a thick feed spacer. Benefits of the FilmTec™ SW30HRLE-440i Element include:

- Helps systems to be designed and operated to either lower operating cost through reduced energy consumption, or to decrease capital cost through higher productivity at lower operating fluxes.
- High NaCl and boron rejection to help meet World Health Organization (WHO) and other drinking water standards.
- Very high guaranteed active area of 440 ft^2 (41 m^2) permits lower system cost by maximizing productivity and facilitating accurate and predictable system design and operating flux.
- The combination of very high active area with a thick feed spacer (28 mil) allows low cleaning frequency and high cleaning efficiency.
- Utilization of the distinct iLEC™ Interlocking Endcaps that help reduce system operating costs and the risk of O-ring leaks that can cause poor water quality (see iLEC™ Technology – Benefits of Use (Form No. 45-D01135-en) for information on cost-saving benefits).
- Sustainable high performance over the operating lifetime of the element, because oxidative treatments are not used in membrane production. This is one reason FilmTec™ Elements are more durable and may be cleaned more effectively over a wider pH range (1 – 13) than most other RO elements, which use oxidative treatments.
- Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.

Product Type

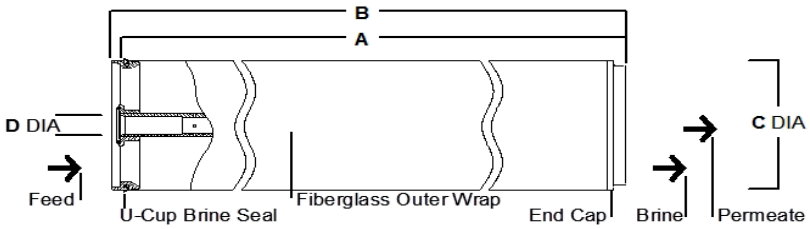
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30HRLE-440i	440	41	28	8,000	30.2	92	99.80

1. The above values are normalized to the following conditions: 32,000 ppm NaCl, 5 ppm boron, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ± 15%.
3. Minimum Salt Rejection is 99.65%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ± 5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30HRLE-440i	40.0	1,016	40.5	1.029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ Interlocking Endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
- Storage and Shipping of New FilmTec™ Elements (Form No. 45-D01633-en)

Product Stewardship

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Please be aware of the following:

- 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.

FilmTec™ SW30XHR-400

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements designed to produce high quality water which may reduce capital and operation cost of seawater RO systems. These products combine premium membrane performance with automated precision fabrication to provide reliable and consistent performance.

FilmTec™ SW30XHR-400 Elements are the highest rejection seawater RO elements in the FilmTec™ Element portfolio, enabling stringent water quality requirements to be met with single-pass seawater systems in most situations. Benefits of the FilmTec™ SW30XHR-400 Element include:

- Very high NaCl and boron rejection to help meet World Health Organization (WHO) and other drinking water standards more cost effectively.
- Guaranteed active area of 400 ft^2 maximizes productivity and enables accurate and predictable system design and operating flux.
- Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.
- High performance over the operating lifetime without the use of oxidative post-treatments. FilmTec™ Elements are more durable and may be cleaned over a wider pH range (1 – 13) than other RO elements.
- Automated, precision fabrication with a greater number of shorter membrane leaves reducing the effect of overall fouling and maximizing element efficiency.

Product Type

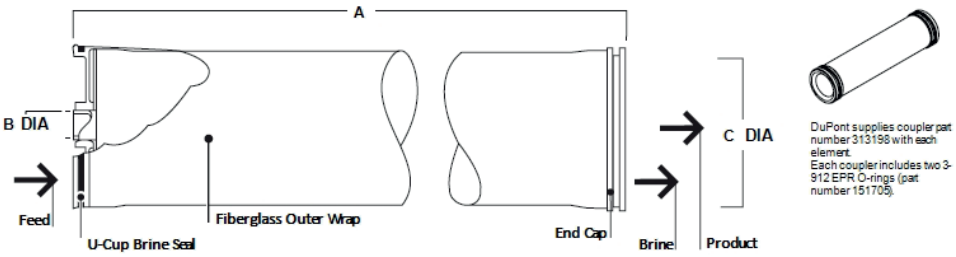
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30XHR-400	400	37	28	6,000	23	93	99.82

1. The above benchmark values are based on the following test conditions: 32,000 ppm NaCl, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ± 15%.
3. Minimum Salt Rejection is 99.70%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ± 5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30XHR-400	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to technical bulletin Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
- Storage and Shipping of New FilmTec™ Elements (Form No. 45-D01633-en)

Product Stewardship

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Please be aware of the following:

- 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.

FilmTec™ SW30XHR-440

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements designed to produce high quality water which may reduce capital and operation costs of desalination systems. FilmTec™ Elements combine excellent membrane quality with automated precision fabrication to take system performance to exceptional levels.

FilmTec™ SW30XHR-440 Elements are the highest rejection seawater RO elements in the FilmTec™ Element portfolio, enabling stringent water quality requirements to be met reliably with single-pass seawater systems in most situations. In addition, the combination of highest active area and a thick feed spacer results in higher productivity and lower cleaning frequency, which enables sustainable lower life-cycle cost. Benefits of the FilmTec™ SW30XHR-440 Element include:

- Highest NaCl and boron rejection to help meet World Health Organization (WHO) and other drinking water standards more cost effectively.
- The highest guaranteed active area of 440 ft^2 (41 m^2) permits lowest system cost by maximizing productivity and enables accurate and predictable system design and operating flux.
- The combination of highest active area with a thick feed spacer (28 mil) allows low cleaning frequency and high cleaning efficiency.
- Sustainable high performance over the operating lifetime, because oxidative treatments are not used in membrane production. This is one reason FilmTec™ Elements are more durable and may be cleaned more effectively over a wider pH range (1 – 13) than most other RO elements, which use oxidative treatments.
- Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.

Product Type

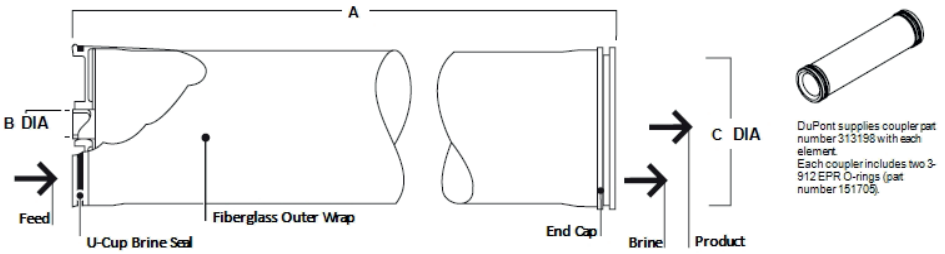
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30XHR-440	440	41	28	6,600	25	93	99.82

1. The above benchmark values are based on the following test conditions: 32,000 ppm NaCl, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ± 20%.
3. Minimum Salt Rejection is 99.7%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ± 5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30XHR-440	40.0	1,016	1.125 ID	29	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
- Storage and Shipping of New FilmTec™ Elements (Form No. 45-D01633-en)

Product Stewardship

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Please be aware of the following:

- 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.

FilmTec™ SW30XHR-440i

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements designed to produce high quality water which may reduce capital and operation costs of desalination systems. FilmTec™ Elements combine excellent membrane quality with automated precision fabrication to take system performance to exceptional levels.

FilmTec™ SW30XHR-440i Elements are the highest rejection seawater RO elements in the FilmTec™ Element portfolio, enabling stringent water quality requirements to be met reliably with single-pass seawater systems in most situations. In addition, the combination of highest active area and a thick feed spacer results in higher productivity and lower cleaning frequency, which enables sustainable lower life-cycle cost. Benefits of the FilmTec™ SW30XHR-440i Element include:

- Highest NaCl and boron rejection to help meet World Health Organization (WHO) and other drinking water standards more cost effectively.
- The highest guaranteed active area of 440 ft^2 (41 m^2) permits lowest system cost by maximizing productivity and enables accurate and predictable system design and operating flux.
- The combination of highest active area with a thick feed spacer (28 mil) allows low cleaning frequency and high cleaning efficiency.
- Utilization of the distinct iLEC™ Interlocking Endcaps helps reduce system operating costs and reduce the risk of O-ring leaks that can cause poor water quality (see iLEC™ Technology – Benefits of Use (Form No. 45-D01135-en) for information on the cost-saving benefits).
- Sustainable high performance over the operating lifetime, because oxidative treatments are not used in membrane production. This is one reason FilmTec™ Elements are more durable and may be cleaned more effectively over a wider pH range (1 – 13) than most other RO elements, which use oxidative treatments.
- Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.

Product Type

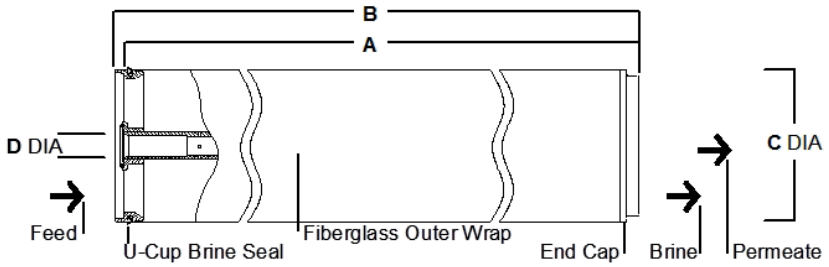
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30XHR-440i	440	41	28	6,600	25	93	99.82

1. The above benchmark values are based on the following test conditions: 32,000 ppm NaCl, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ±20%.
3. Minimum Salt Rejection is 99.7%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ±5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30XHR-440i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ Interlocking Endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
- Storage and Shipping of New FilmTec™ Elements (Form No. 45-D01633-en)

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Please be aware of the following:

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FilmTec™ SW30XLE-400

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements to reduce capital and operation cost of seawater RO systems. FilmTec™ Elements combine premium membrane performance with automated precision fabrication and maximize system output to exceptional performance.

FilmTec™ SW30XLE-400 Elements offer a great combination of productivity and rejection. It is an excellent choice for two-pass seawater designs and high TDS brackish water applications. Benefits of the FilmTec™ SW30XLE-400 Element include:

- High productivity, with active area of 400 ft^2, helps systems to be designed to deliver low total cost of water by optimizing energy consumption, system productivity and operating flux.
- Can effectively be used in permeate staged seawater desalination systems without impairing the performance of the downstream stage.
- Delivers high performance over the operating lifetime without the use of oxidative post-treatments like many competitive products. This is one reason FilmTec™ Elements are more durable and may be cleaned more effectively over a wider pH range (1 – 13) than other RO elements.
- Automated, precision fabrication with a greater number of shorter membrane leaves reduces the effect of overall fouling and maximizes element efficiency, helping to lower your cost of operation.

Product Type

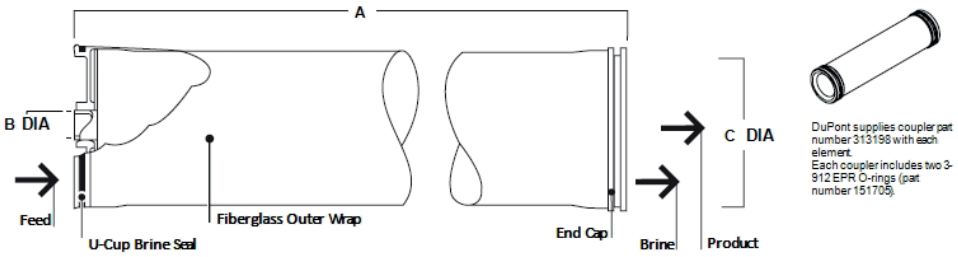
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30XLE-400	400	37	28	9,000	34	91.5	99.8

1. The above values are normalized to the following conditions: 32,000 ppm NaCl, 5 ppm boron, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ± 15%.
3. Minimum Salt Rejection is 99.6%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ± 5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30XLE-400	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
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FilmTec™ SW30XLE-440

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements designed to help reduce capital and operation cost of desalination systems. FilmTec™ Elements combine excellent membrane quality with automated precision fabrication which takes system performance to exceptional levels.

FilmTec™ SW30XLE-440 Elements offer medium-salinity and medium-temperature feedwaters an advanced combination of high productivity and high rejection through extra-low energy consumption and single-pass design. It is also an excellent choice for two-pass seawater designs or high salinity brackish water applications. The combination of high active area and thick feed spacer facilitates high productivity and low cleaning frequency, which enables sustainable low life-cycle cost. Benefits of the FilmTec™ SW30XLE-440 Element include:

- High active area of 440 ft^2 (41 m^2) permits low system capital cost by maximizing productivity and enables accurate and predictable system design and operating flux.
- The combination of high active area with thick feed spacer (28 mil) allows low cleaning frequency and high cleaning efficiency.
- Sustainable high performance over the operating lifetime, because oxidative treatments are not used in membrane production. This is one reason FilmTec™ Elements are more durable and may be cleaned more effectively over a wider pH range (1 – 13) than most other RO elements, which use oxidative treatments.
- Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.

Product Type

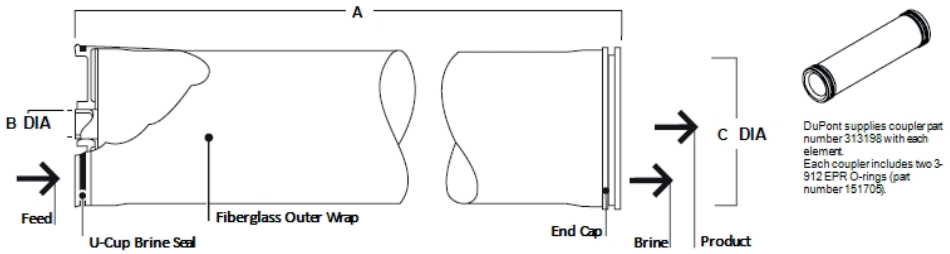
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30XLE-440	440	41	28	9,900	37.4	91.5	99.8

1. The above benchmark values are based on the following test conditions: 32,000 ppm NaCl, 5 ppm boron, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ± 15%.
3. Minimum Salt Rejection is 99.6%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ± 5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)						1 inch = 25.4 mm
	A		B		C	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30XLE-440	40.0	1,016	1.125 ID	29 ID	7.9	201

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
- Storage and Shipping of New FilmTec™ Elements (Form No. 45-D01633-en)

Product Stewardship

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Customer Notice

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Please be aware of the following:

- 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.

FilmTec™ SW30XLE-440i

Description

DuPont Water Solutions offers various premium seawater reverse osmosis (RO) elements designed to help reduce capital and operation cost of desalination systems. FilmTec™ Elements combine excellent membrane quality with automated precision fabrication which takes system performance to exceptional levels.

FilmTec™ SW30XLE-440i Elements offer medium-salinity and medium-temperature feedwaters an advanced combination of high productivity and high rejection through extra-low energy consumption and single-pass design. It is also an excellent choice for two-pass seawater designs or high salinity brackish water applications. The combination of high active area and thick feed spacer facilitates high productivity and low cleaning frequency, which enables sustainable low life-cycle cost. Benefits of the FilmTec™ SW30XLE-440i Element include:

- High active area of 440 ft^2 (41 m^2) permits low system capital cost by maximizing productivity and enables accurate and predictable system design and operating flux.
- The combination of high active area with thick feed spacer (28 mil) allows low cleaning frequency and high cleaning efficiency.
- Utilization of the distinct iLEC™ Interlocking Endcaps helps reduce system operating costs and reduce the risk of O-ring leaks that can cause poor water quality (see iLEC™ Technology – Benefits of Use (Form No. 45-D01135-en) for information on the cost-saving benefits).
- Sustainable high performance over the operating lifetime, because oxidative treatments are not used in membrane production. This is one reason FilmTec™ Elements are more durable and may be cleaned more effectively over a wider pH range (1 – 13) than most other RO elements, which use oxidative treatments.
- Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.

Product Type

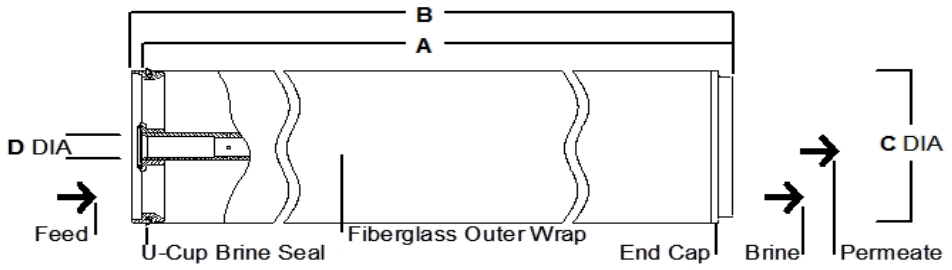
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flowrate (gpd)	Permeate Flowrate (m^3/d)	Stabilized Boron Rejection (%)	Stabilized Salt Rejection (%)
SW30XLE-440i	440	41	28	9,900	37.4	91.5	99.8

1. The above benchmark values are based on the following test conditions: 32,000 ppm NaCl, 5 ppm boron, 800 psi (5.5 MPa), 77°F (25°C), pH 8, 8% recovery.
2. Permeate flows for individual elements may vary ± 15%.
3. Minimum Salt Rejection is 99.6%.
4. Stabilized salt rejection is generally achieved within 24 – 48 hours of continuous use, depending upon feedwater characteristics and operating conditions.
5. Product specifications may vary slightly as improvements are implemented.
6. Active area guaranteed ± 5%. Active area as stated by DuPont Water Solutions is not comparable to the nominal membrane area figure often stated by some element suppliers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)
SW30XLE-440i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ Interlocking Endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a, b]	113°F (45°C)
Maximum Operating Pressure [b]	1,200 psig (83 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-term Cleaning (30 min) [c]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [d]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Consult your DuPont representative for advice on applications above 95°F (35°C). Refer to FilmTec™ Elements Operating Limits (Form No. 45-D00691) for warranty-voiding conditions and additional information.
c. Refer to guidelines in Cleaning Guidelines (Form No. 45-D01696-en) for more information.
d. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)
- Storage and Shipping of New FilmTec™ Elements (Form No. 45-D01633-en)

Product Stewardship

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Please be aware of the following:

- 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.

FilmTec™ NF270 - 2540 & 4040

Description

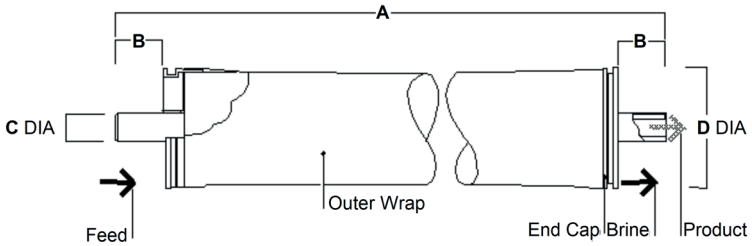
The FilmTec™ NF270 Nanofiltration Elements are ideal for removing a high percentage of TOC and THM precursors with medium to high salt passage and medium hardness passage. The FilmTec™ NF270 Membrane is an ideal choice for surface water and ground water where good organic removal is desired with partial softening.

Typical Properties

Product	Part Number	Active Area ft^2 (m^2)	Applied Pressure psig (bar)	Permeate Flow Rate gpd (m^3/d)	Stabilized Salt Rejection (%)
NF270-2540	149986	28 (2.6)	70 (4.8)	850 (3.2)	>97.0
NF270-4040	149987	82 (7.6)	70 (4.8)	2,500 (9.5)	>97.0

1. Permeate flow and salt rejection based on the following test conditions: 2,000 ppm $MgSO_4$, 77°F (25°C) and 15% recovery at the pressure specified above.
2. Permeate flows for individual NF270-2540 elements may vary by -20% / +30%. NF270-4040 individual elements may vary -15% / +50%.
3. Developmental products available for sale.

Element Dimensions



FilmTec sells coupler part numb 89055 for use in multiple elemer housings. Each coupler includes two 2-210 EPR o-rings, FilmTec part number 89255.

Product	Dimensions – Inches (mm) A	B	C	D	1 inch = 25.4 mm
NF270-2540	40.0 (1,016)	1.19 (30)	0.75 (19)	2.4 (61)	
NF270-4040	40.0 (1,016)	1.05 (27)	0.75 (19)	3.9 (99)	

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of midsize elements (Form No. 45-D01588-en).
2. NF270-2540 has a tape outer wrap. NF270-4040 has a fiberglass outer wrap.

Operating and Cleaning Limits

Membrane Type	Polyamide Thin-Film Composite
Maximum Operating Temperature	113°F (45°C)
Maximum Operating Pressure	600 psi (41 bar)
Maximum Feed Flow Rate	
4040 elements	16 gpm (3.6 m^3/hr)
2540 elements	6 gpm (1.4 m^3/hr)
Maximum Pressure Drop	
tape wrapped	13 psig (0.9 bar)
fiberglassed	15 psig (1.0 bar)
pH Range	
Continuous Operation[a]	2 - 11
Short-Term Cleaning (30 min.)[b]	1 - 12
Maximum Feed Silt Density Index	SDI 5
Free Chlorine Tolerance[c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en) for NF90.
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPontWater Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en) for more information.

Important Information

Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence (Form No. 45-D01609-en) for more information.

Operation Guidelines

Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a standstill to operating state is recommended as follows:

- Feed pressure should be increased gradually over a 30-60 second time frame.
- Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.

General Information

- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements.
- Maximum pressure drop across an entire pressure vessel (housing) is 30 psi (2.1 bar).
- Avoid static permeate-side backpressure at all times.

Product Stewardship

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FilmTec™ NF270-400/34i

Description

Ideal for: utility managers and operators dealing with surface and groundwater and seeking a technology that removes a high percentage of total organic carbon (TOC) and trihalomethan (THM) precursors while having a medium to high salt passage and medium hardness passage.

The FilmTec™ NF270-400/34i Element:

- Provides organic removal with partial softening in order to maintain a minimum level of hardness for organoleptic properties and preservation of distribution networks
- Delivers high productivity, cleanability and low energy consumption due to its high active area and wide cleaning pH range (1-12) tolerance
- Includes iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

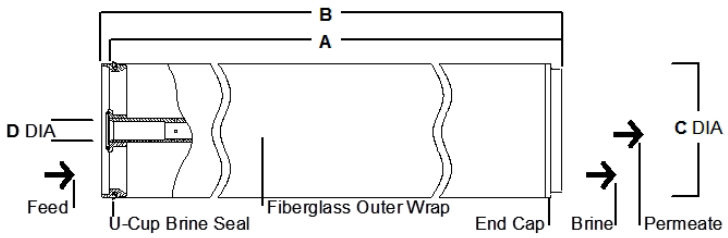
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

FilmTec™ Element	Active Area (ft^2)	Active Area (m^2)	Feed Spacer Thickness (mil)	Permeate Flow Rate (GPD)	Permeate Flow Rate (m^3/d)	Typical Stabilized Salt Rejection (%)	Minimum Salt Rejection (%)
NF270-400/34i	400	37	34-LDP	12,500	47	>97.0	97.0

1. Permeate flow and salt passage based on the following test conditions: 2,000 mg/l $MgSO_4$, 70 psi (4.8 bar), 77°F (25°C) and 15% recovery.
2. Flow rates for individual elements may vary but will be no more than ±15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ±3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
NF270-400/34i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	3 - 10
Short-Term Cleaning (30 min.) [b]	1 - 12
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

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Please be aware of the following:

- 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.
- Permeate obtained from the first hour of operation should be discarded.

FilmTec™ NF90 - 2540 & 4040

Description

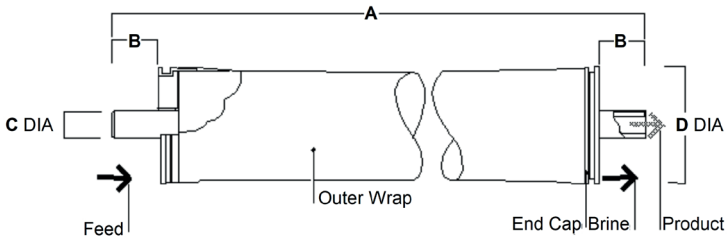
The FilmTec™ NF90 Membrane Elements provide high productivity performance while removing a high percentage of salts, nitrate, iron and organic compounds such as pesticides, herbicides and THM precursors. The low net driving pressure of the NF90 membrane allows the removal of these compounds at low operating pressures.

Typical Properties

Product	Part Number	Applied Pressure psig (bar)	Permeate Flow Rate gpd (m^3/d)	Minimum Salt Rejection (%)
NF90-2540	149982	70 (4.8)	680 (2.6)	97.0
NF90-4040	149983	70 (4.8)	2,000 (7.6)	98.7

1. Permeate flow and salt rejection based on the following test conditions: 2,000 ppm $MgSO_4$, 77°F (25°C) and 15% recovery at the pressure specified above.
2. Permeate flows for individual NF90-2540 Elements may vary by -20% / +30%. NF90-4040 individual elements may vary -15% / +50%.
3. Developmental products available for sale.

Element Dimensions



FilmTec sells coupler part number 89055 for use in multiple element housings. Each coupler includes two 2-210 EPR o-rings, FilmTec part number 89255.

Dimensions – Inches (mm)				1 inch = 25.4 mm
Product	A	B	C	D
NF90-2540	40.0 (1,016)	1.19 (30)	0.75 (19)	2.4 (61)
NF90-4040	40.0 (1,016)	1.05 (27)	0.75 (19)	3.9 (99)

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of midsize elements (Form No. 45-D01588-en).
2. NF90-2540 has a tape outer wrap. NF90-4040 has a fiberglass outer wrap.

Operating and Cleaning Limits

Membrane Type	Polyamide Thin-Film Composite
Maximum Operating Temperature	113°F (45°C)
Maximum Operating Pressure	600 psi (41 bar)
Maximum Feed Flow Rate	
4040 elements	16 gpm (3.6 m^3/hr)
2540 elements	6 gpm (1.4 m^3/hr)
Maximum Pressure Drop	
tape wrapped	13 psig (0.9 bar)
fiberglassed	15 psig (1.0 bar)
pH Range	
Continuous Operation[a]	2 – 11
Short-Term Cleaning (30 min.)[b]	1 – 12
Maximum Feed Silt Density Index	SDI 5
Free Chlorine Tolerance[c]	<0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en) for NF90.
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en) for more information.

Important Information

Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence (Form No. 45-D01609-en) for more information.

Operation Guidelines

Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a standstill to operating state is recommended as follows:

- Feed pressure should be increased gradually over a 30-60 second time frame.
- Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.

General Information

- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements.
- Maximum pressure drop across an entire pressure vessel (housing) is 30 psi (2.1 bar).
- Avoid static permeate-side backpressure at all times.

Product Stewardship

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FilmTec™ NF90-400/34i

Description

Ideal for: utility managers and operators looking for a technology that delivers high quality permeate water while removing specific contaminants such as salts, nitrates, iron, and organic compounds.

The FilmTec™ NF90-400/34i Element:

- Delivers high productivity and cleanability due to its high active area and widest cleaning pH range (1-13) tolerance
- Offers a nanofiltration technology that selectively removes these components, color and operates at low operating pressures
- Including iLEC™ interlocking end caps, reducing system operating costs and the risk of o-ring leaks that can cause poor water quality

Product Type

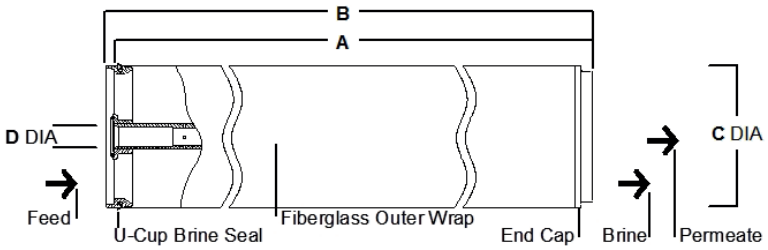
Spiral-wound element with polyamide thin-film composite membrane

Typical Properties

	Active Area			Permeate Flow Rate		
FilmTec™ Element	(ft^2)	(m^2)	Feed Spacer Thickness (mil)	(GPD)	(m^3/d)	Minimum Salt Rejection (%)
NF90-400/34i	400	37	34-LDP	10,000	38	98.7%

1. Permeate flow and salt passage based on the following test conditions:2,000 mg/l $MgSO_4$, 70 psi (4.8 bar), 77°F (25°C) and 15% recovery.
2. Flow rates for individual elements may vary but will be no more than +15%.
3. Stabilized salt rejection is generally achieved within 24-48 hours of continuous use; depending upon feedwater characteristics and operating conditions.
4. Sales specifications may vary as design revisions take place.
5. Active area guaranteed ± 3%. Active area as stated by DuPont Water Solutions is not comparable to nominal membrane area often stated by some manufacturers.

Element Dimensions



Dimensions – inches (mm)								1 inch = 25.4 mm
	A		B		C		D	
FilmTec™ Element	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
NF90-400/34i	40.0	1,016	40.5	1,029	7.9	201	1.125 ID	29 ID

1. Refer to FilmTec™ Design Guidelines for multiple-element systems of 8-inch elements (Form No. 45-D01695-en).
2. Element to fit nominal 8-inch (203-mm) I.D. pressure vessel.
3. Individual elements with iLEC™ endcaps measure 40.5 inches (1,029 mm) in length (B). The net length (A) of the elements when connected is 40.0 inches (1,016 mm).

Operating and Cleaning Limits

Maximum Operating Temperature [a]	113°F (45°C)
Maximum Operating Pressure	600 psig (41 bar)
Maximum Element Pressure Drop	15 psig (1.0 bar)
pH Range	
Continuous Operation [a]	2 – 11
Short-Term Cleaning (30 min.) [b]	1 – 13
Maximum Feed Silt Density Index (SDI)	SDI 5
Free Chlorine Tolerance [c]	< 0.1 ppm

a. Maximum temperature for continuous operation above pH 10 is 95°F (35°C).
b. Refer to Cleaning Guidelines (Form No. 45-D01696-en).
c. Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty, DuPont Water Solutions recommends removing residual free chlorine by pretreatment prior to membrane exposure. Please refer to Dechlorinating Feedwater (Form No. 45-D01569-en) for more information.

Additional Important Information

Before use or storage, review these additional resources for important information:

- Usage Guidelines for FilmTec™ 8" Elements (Form No. 45-D01706-en)
- Start-Up Sequence (Form No. 45-D01609-en)

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Membrane Sanitarie RO FilmTec™ / FilmTec™ Sanitary RO Membranes

Description

Certified to NSF/ANSI 61

IDEAL for: Water Treatment Plant managers and operators looking for a state-of-the art Sanitary Desalination solution for reducing CAPEX and OPEX in Food & Beverage

FilmTec™ Reverse Osmosis (RO) Membrane Elements contain sanitary, high-rejection FT30 reverse osmosis membrane that has been successfully used to process a wide range of food and beverage streams including Bottled Water, Juice, Soft Drinks, non-Dairy milk products and many others

These elements deliver high flux and outstanding quality water for applications requiring sanitary grade membrane elements.

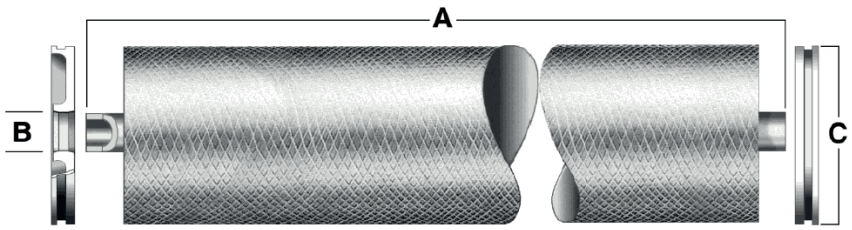
The full-fit configuration minimizes stagnant areas and is optimal for applications requiring a

Sanitary design. All components comply with FDA indirect food contact.

Product Overview

FilmTec™ Membranes	Part Number	Active Area $ft^2(m^2)$	Stabilized Permeate Flow Rate gpd (m3/d)	Typical Stabilized Salt Rejection (%)
RO-4040-FF	84286	90 (8.36)	2650 (10.0)	99.5
RO-390-FF	116314 / 100608	390 (36.23)	13,700 (51.8)	99.5

Element Dimensions



	A		B		C	
FilmTec™ Membranes	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
RO-4040-FF	40.00	1,016	0.75 OD	19	3.9	99
RO-390-FF	40.00	1,016	1.125 ID	28.58	7.9	200

Operating and Cleaning Limits

Membrane Type	Thin-Film Composite
Maximum Operating Temperature	113ºF (45ºC)
Maximum Operating Pressure	600 psi (41 bar)
Maximum Differential Pressure	15 psi (1.0 bar)
Maximum Feed Turbidity	1 NTU
Free Chlorine Tolerance	Below Detectable Limits
pH Range	
Continuous Operations	3 – 10
Short-Term Cleaning (30 min)*	1 – 12
Maximum Feed Silt Density Index (SDI)	5

* Refer to Cleaning Guidelines (Form No. 45-D01696-en)

Additional Important Information

Proper start-up of reverse osmosis water treatment systems is essential to prepare the membranes for operating service and to prevent membrane damage due to overfeeding or hydraulic shock. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved.

Before initiating system start-up procedures, membrane pretreatment, loading of the membrane elements, instrument calibration and other system checks should be completed.

Please refer to the application information literature entitled Start-Up Sequence (Form No. 45-D01609-en) for more information.

Operation Guidelines

Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start up, a gradual change from a standstill to operating state is recommended as follows:

- Feed pressure should be increased gradually over a 30-60 second time frame.
- Cross-flow velocity at set operating point should be achieved gradually over 15-20 seconds.

General Information

- Keep elements moist at all times after initial wetting.
- If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty will be null and void.
- To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.
- The customer is fully responsible for the effects of incompatible chemicals and lubricants on elements.
- Maximum pressure drop across an entire pressure vessel (housing) is 60 psi (4.1 bar).
- Avoid permeate-side backpressure at all times.

Product Stewardship

DuPont has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with DuPont products—from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

MEMBRANE HSRO FILMTEC SANITIZZABILI CON ACQUA CALDA / FILMTEC HSRO MEMBRANES FOR HEAT SANITIZABLE RO ELEMENTS

HSRO

CARATTERISTICHE GENERALI:
Le membrane FILMTEC HSRO sanitizzabili, offrono l' opportunità di produrre acqua osmotizzata di alta qualità ed essere contemporaneamente sanitizzate con acqua calda. Le membrane HSRO sono il prodotto di un alto standard produttivo che mette a disposizione un' altissima superficie filtrante. Questa grande superficie, permette la progettazione di impianti a bassa pressione con l' utilizzo di un minor numero di membrane. La configurazione della membrana HSRO, è stata studiata per minimizzare le potenziali aree stagnanti . Tutti i componenti della HSRO sono conformi agli standard FDA:

LIMITI E CARATTERISTICHE OPERATIVE:
- Materiale membrana: _____ Polyamide Thin-Film Composite
- Temperatura massima di esercizio: _____ 113°F (45°C)
- Temperatura Massima di sanitizzazione a 1,7 bar:___ 85°C (185°F)
- Pressione massima di esercizio:_____ 600 psig (41 bar)
- Perdita di carico massima: _____ 15 psig (1,0 bar)
- pH Range in continuo : _____ 2 fi 11
- pH Range limitato per lavaggio (30 min.): _____ 1 fi 12
- SDI massimo: _____ 5
- Tolleranza al cloro libero: _____ <0.1 ppm

CERTIFICAZIONI
- Standard FDA

APPLICAZIONI:
- Tutti i sistemi RO con richieste specifiche di sanitizzazione
- Sistemi RO per utilizzi tecnologici con richiesta specifica di sanitizzazione
- Applicazioni di laboratorio con possibilità di sanitizzazione

GUIDA OPERATIVA:
Le nuove membrane a spirale HSRO, devono necessariamente essere pre-condizionate prima del loro utilizzo tramite un flussaggio blando con acqua calda:
• Flussare a bassa pressione con acqua osmotizzata e con bassa produzione di permeato.
• Fare un ricircolo con acqua calda non superiore ai 45°C a bassa pressione (pressione di attraversamento membrana non superiore a 1,7 bar, con pressione massima in alimento di 3 bar).
• Introdurre l' acqua calda nell' impianto raggiungendo la temperatura di 80°C (176°F).
• Mantenere sempre la pressione di attraversamento membrana al di sotto di 1,7 bar, anche quando il permeato viene utilizzato come acqua di flussaggio.
• Mantenere la temperatura costante per almeno 60-90 minuti.
• Portare la temperatura di ricircolo a 45°C (o meno)
• Flussare nuovamente con acqua osmotizzata a bassa pressione (pressione di attraversamento membrana non superiore a 1,7 bar, con pressione massima in alimento di 3 bar).

INFORMAZIONI GENERALI:
Evitare brusche variazioni di pressione e di flussi al momento della messa in funzione, dello spegnimento sospensione dell'attività, pulizia dell' impianto ecc, per non danneggiare la membrana osmostica. Tra una fermata e una messa in funzione dell' impianto, raccomandiamo che:
• la pressione di alimento deve aumentare gradualmente ed arrivare a pieno regime nel giro di 30-60 secondi.

HSRO

GENERAL FEATURES:
FILMTEC HSRO heat sanitizable reverse osmosis membrane elements deliver outstanding quality water with the added capability to withstand sanitization with hot water. HSRO elements, manufactured on advanced automated equipment, have the highest active membrane area in the industry. This high area allows system designs with either lower operating flux or cost savings from fewer membrane elements. The full-fit configuration minimizes stagnant areas and is optimal for applications requiring a sanitary design. All components comply with FDA standards.

OPERATING LIMITS FEATURES:
- Membrane Type: _____ Polyamide Thin-Film Composite
- Maximum Operating Temperature: _____ 113°F (45°C)
- Maximum Sanitization Temperature @ 25 psing:____185°F (85°C)
- Maximum Operating Pressure: _____ 600 psig (41 bar)
- Maximum Pressure Drop: _____ 15 psig (1,0 bar)
- pH Range, Continuous Operation: _____ 2 fi 11
- pH Range, Short-Term Cleaning (30 min.): _____ 1 fi 12
- Maximum Feed Silt Density Index (SDI): _____ 5
- Free Chlorine Tolerancec: _____ <0.1 ppm

CERTIFICATIONS:
- FDA Standard

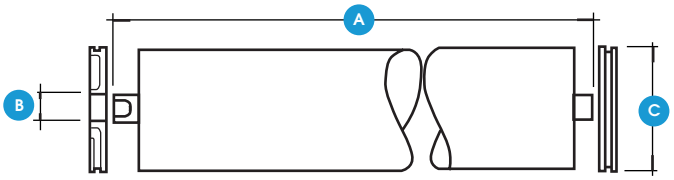
APPLICATIONS:
- All RO sistem where is a sanitizable demand
- RO technical system where is a sanitizable demand
- Laboratory applications system where is a sanitizable demand

OPERATION GUIDELINES:
New HSRO heat sanitizable spiral elements must be pre-conditioned prior to initial use by exposure to hot water. An appropriate conditioning procedure consists of the following:
• Flush to drain with suitable quality water at low pressure and low permeate flow rate.
• Recycle warm water (45°C or less) at very low pressure (< 25 psig trans-membrane pressure with a maximum feed pressure of 45 psig (3 bar)).
• Introduce hot water to the system to increase temperature to 80°C (176°F).
• Keep trans-membrane pressure below 25 psig (1.7 bar) when warm or hot water (45°Cor higher) is being fed to the membranes.
• Maintain temperature for 60-90 minutes.
• Allow system to cool to 45°C or below.
• Flush to drain with suitable water quality at very low pressure (< 25 psig trans-membrane pressure with maximum feed pressure of 45 psig (3 bar)).

GENERAL INFORMATION:
Avoid any abrupt pressure or cross-flow variations on the spiral elements during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. During start-up, a gradual change from a stand still to operating state is recommended as follows:
• Feed pressure should be increased gradually over a 30-60 second time frame.

di un vessel è di 4.1 bar (60 psi).
• Evitare sempre contro pressioni statiche sul tubo del permeato.
• Tenere le membrane umide dopo la prima bagnatura.
• Se i limti del presente bollettino tecnico non vengono osservati scrupolosamente, la garanzia delle membrane potrebbe decadere e diventare nulla.
• La prima acqua permeata prodotta nella prima ora di esercizio dovrebbe essere scartata.
• Per prevenire la proliverazione batterica durante lo stoccaggio, spedizione dell' impianto o fermo macchina, si raccomanda la bagbatura con una soluzione di conservazione. Una soluzione conservante standard da utilizzare è il meta-bi-solfito di sodio al 1.5% in peso (certificato per alimenti).
• In caso si utilizzasse la formaldeide come prodotto biocida, occorrerà attendere almeno sei ore di esercizio a regime dell' impianto RO, causa l' alterazione dei parametri di funzionamento tra i quali una riduzione di portata.
• La membrana è resistente per un breve periodo al contatto con cloro (ipoclorito). Il contatto prolungato e superiore agli 0,1 ppm potrebbe danneggiare irreversibilmente la membrana.
• Il cliente è interamente responsabile per l' utilizzo di prodotti chimici di lavaggio ed eventuali lubrificanti incompatibili con la membrana. Tale responsabilità limiterà o annullera la garanzia.

(housing) is 60 psi (4.1 bar).
• Avoid static permeate-side backpressure at all times.
• Keep elements moist at all times after initial wetting.
• If operating specifications given in the Product Information bulletin are not strictly followed, the limited warranty will be null and void.
• Permeate obtained from first hour of operation should be discarded.
• To prevent biological growth during storage, shipping or 5. Elements must be in use for at least six hours before formaldehyde is used as a biocide. If the elements are exposed to formaldehyde before being in use tor this period of time, a loss in flux may result.
• Elements must be in use for at least six hours before formaldehyde is used as a biocide. If the elements are exposed to formaldehyde before being in use tor this period of time, a loss in flux may result.
• The membrane shows some resistance to short-term attack by chlorine (hypochlorite). Continuous exposure, however, may damage the membrane and should be avoided.
• The customer is fully responsible for the effects of incompatible chemicals on elements. Their use will void the element limited warranty.



Dimensioni / Dimensions

Prodotto Product	Recupero massimo per singolo elemento (Permeato/Alimento) Single-Element Recovery (Permeate Flow to Feed Flow)	A inch (mm)	B inch (mm)	C inch (mm)
HSRO-4040-FF	15%	40.0 (1,016)	0.75 (19)	3.9 (99)
HSRO-390-FF	15%	40.0 (1,016)	1.13 (28.6)	7.9 (200)

Le HSRO-4040-FF possono essere utilizzate con vessels con diametro di 4"nominale. HSRO-390-FF possono essere utilizzate con vessels con diametro di 8"nominale.
HSRO-4040-FF fits nominal 4 inch I.D. pressure vessels. HSRO-390-FF fits nominal 8 inch I.D. pressure vessels.

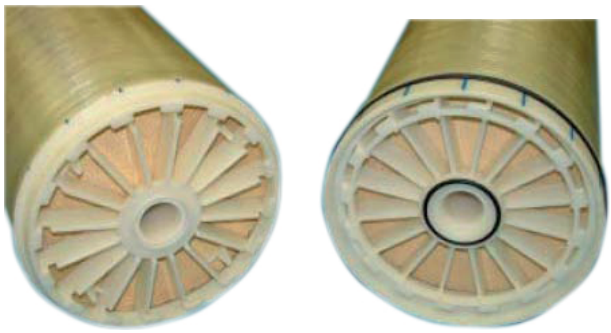
1 inch = 25.4 mm

Specifiche del prodotto / Product Specifications

Modello Model	Area filtrante ft^2 (m^2) Active area ft^2 (m^2)	Pressione applicata psig (bar) Applied Pressure psig (bar)	Produzione Permeato gpd (m3/g) Permeate Flow Rate gpd (m3/g)	Reiezione Stabilizzata (%) Stabilized Salt Rejection (%)
HSRO-4040-FF	90 (8.4)	150 (10.3)	1,900 (7.2)	99.5
HSRO-390-FF	390 (36)	150 (10.3)	9,000 (34)	99.5

1.Produzione Permeato e reiezione salina basati sulle seguenti condizioni di test: 2000 ppm NaCl, pressione 150 psi (10.3 bar), 77˚F (25˚C) e recupero del 15%.
Permeate flow and salt rejection based on the following test conditions: 2000 ppm NaCl, pressure 150 psi (10.3 bar), 77˚F (25˚C) and 15% recovery.
2.La produzione del permeato può variare da membrana a membrana del +/-20%.
Permeate flows for individual elements may vary +/-20%.
3. Le membrane, per stabilizzarsi, devono necessariamente essere pre-condizionate prima del loro utilizzo. Durante la stabilizzazione, e per un certo periodo, il flusso sarà più basso di quello riportato nelle sopracitate schede tecniche.
Elements must be conditioned prior to start-up. A one-time flux loss will occur during stabilization. Listed values apply after performance stabilization.
4. Per motivi di miglioramento del prodotto, i dati possono subire delle modifiche periodiche
For the purpose of improvement, specifications may be updated periodically.
5. Le membrane HSRO-4040-FF sostituiscono il modello obsoleto SG30-85-HS. Le membrane HSRO-390-FF sostituiscono il modello obsoleto SG30-390-HS.
HSRO-4040-FF was previously named SG30-85-HS. HSRO-390-FF was previously named SG30-390-HS.

iLEC™ SYSTEM: UN NUOVO CONCETTO DI INTERCONNESSIONE TRA MEMBRANE FILMTEC / iLEC™ SYSTEM: A NEW CONCEPT FOR INTERCONNECTING FILMTEC ELEMENTS



II. Criteri progettuali per un nuovo interconnettore

Il successo e i criteri che hanno portato alla progettazione dei nuovi sistemi iLEC™ sono illustrati di seguito:

• 2.1 Grande Integrità di tenuta

Criterio 1: inferiore area di tenuta

fi L' inferiore area di tenuta porta ad avere un' area di tenuta più piccola e di conseguenza minori rischi di rottura. Si possono prevedere meno interconnettori di ricambio per i bassi rischi di rottura e la facilità estrema di interconnessione.

Criterio 2: Tenuta precisa e inamovibile

- L' interconnessione tra membrana-membrana è stata migliorata riducendo le tolleranze così da poter connettere le membrane più di una volta senza problemi.

Criterio 3: Eliminate le abrasioni dell' oring.

- Il movimento delle membrane durante l' avviamento e il fermo impianto causa inevitabilmente l' abrasione dell' oring. Questo può portare col tempo ad una diminuzione della qualità del permeato e una rottura degli o-ring di interconnessione. Il grasso siliconico può ridurre questi rischi, ma spesso non viene utilizzato. Si può intuire come un collegamento rigido, preciso e altamente statico, riduce notevolmente gli atriti e le abrasioni.

Criterio 4: Effetti delle perdite di carico e dei flussi indotti

- Le membrane RO all' interno del vessel, sono soggette a carichi di pressioni indotti e proporzionali alle perdite di carico dell' impianto. L' interconnessione precisa e statica dei sistemi iLEC™, limitano gli effetti negativi indotti da forze assiali e di compressione, rendendo l' impianto più rigido e performante

• 2.2 Perdite ridotte - performance durante l' avviamento

Criterio 5: Nessun rollio o pizzichio dell' o-ring.

fi Durante l' installazione delle membrane all' interno del vessel, gli o-ring possono subire abrasioni o spostamenti dalla sede, così come l' interconnettore. Col nuovo sistema iLEC™ questi rischi potenziali verranno totalmente eliminati.

Criterio 6: Protezione della superficie di tenuta

fi Durante l' inserimento delle membrane nei vessels, queste vengono spesso fatte girare favorendo l' atrito tra o-ring e parti statiche del contenitore. Inoltre nelle fasi di manutenzione, le membrane vengono spinte fuori dal vessel causando atriti e rollii. Con il sistema iLEC™ queste problematiche vengone eliminate

• 2.3 Installazione senza l' utilizzo di lubrificanti

Criterio 7: Performance assoluto senza l' utilizzo di lubrificanti

fi Spesso in applicazioni dov' è richiesta acqua ultra pura, l' utilizzo di lubrificante viene evitato per non compromettere la qualità del permeato. Teoricamente l' installazione senza l' utilizzo di lubrificanti, non rende difficile la fase di inserimento delle membrane e non compromette la tenuta dell' oring.

• 2.4 Compatibilità con vessels

Criterio 8: compatibilità con gli adattatori finali dei vessels anche di vecchia produzione

fi Per poter permettere l' utilizzo del nuovo sistema iLEC™ anche su impianti già esistenti, gli interconnettori tappo membrana

II. Design Criteria for a New Interconnector

The success with which the criteria were addressed by the design are evaluated later in this report. The list is as follows:

• 2.1 Long-Term Seal Integrity

Criterion 1: Fewer Seals

fi The improved connection shall have fewer seal surfaces, corresponding to fewer potential leak sites. It must also eliminate redundant backup seals for new simplicity of design and ease of installation.

Criterion 2: Repeatable Seal Compression

fi The improved connection must compress the seal to the same final dimension with repeat ability and with negligible sensitivity to part tolerances or wear.

Criterion 3: Elimination of O-ring Abrasion

fi Relative motion of the elements in a vessel during startup and shutdown causes o-ring abrasion. This can lead to a deterioration in permeate quality over the long term. Movement can also cause o-rings to become pinched, leading to sudden and significant leakage. Silicon grease, while useful for reducing o-ring friction, is often not used. The improved connection will make use of a non-sliding seal between adjacent elements.

Criterion 4: Utilization of Flow-Induced Forces

fi Elements inside a vessel are subject to axial compressive loads proportional to the pressure drop experienced by the flowing feed stream. That compression will be cooperatively deployed to provide sealing forces higher than can be readily obtained during installation.

• 2.2 Leak-Tight Startup Performance

Criterion 5: No Pinching or Rolling

fi During installation, o-rings can be rolled from the groove or pinched and damaged as the couplers are inserted. The potential for rolling and pinching associated with a sliding seal will be eliminated.

Criterion 6: Protected Sealing Surfaces

fi Elements are often set on end or rolled along the edge of an end cap when handled prior to installation. Additionally, push-rods may be used to remove the elements from their pressure vessels. These activities require sensitive sealing surfaces to be recessed and protected from possible damage.

• 2.3 Lubricant - Free Operation

Criterion 7: Full Performance without O-ring Lubricant

fi O-ring lubricants are sometimes omitted in the interest of preserving permeate quality, particularly in ultra pure water (UPW) applications. Ideally, installation without o-ring lubricant will require no additional effort and will not compromise sealing performance.

• 2.4 Backward Compatibility

Criterion 8: Backward-Compatibility with Standard Couplers and Adapters

fi To permit the mixing of element types within a single vessel, the interconnector will remain fully compatible with existing

sono stati resi compatibili con quelli di vecchia generazione.

• 2.5 Risposta immediata sulla corretta interconnessione

Criterio 9: Più indicatori che rilevano immediatamente il successo dell' interconnessione

fi Al momento dell' interconnessione tra membrane, un indicatore visivo e il rumore dell' aggancio a baionetta, indicheranno che la connessione è riuscita perfettamente.

• 2.6 Riduzioni delle perdite di carico sul permeato

Criterio 10: Eliminazione delle restrizioni di flusso

fi Gli adattatori tappo-membrana e membrana-membrana, contribuiscono per più del 70% sulle perdite di carico nel tubo del permeato. iLEC™ elimina le perdite di carico sulla linea del permeato riducendo la pressione in alimento e ottimizzando le performance dell' impianto.

• 2.7 Meccanica rafforzata ed irrobustita

Criterio 11: Capacità di carico

fi Durante l' installazione, una membrana può essere momentaneamente supportata da un' altra già inserita all' interno del vessel. La membrana che fa da supporto, posizionata parzialmente fuori dal vessel, subisce una sollecitazione meccanica importante. Per la progettazione del sistema iLEC™, questo carico è stato considerato con un fattore di sicurezza pari a 2 volte quello critico (vedi figura 1).

couplers and vessel adapters.

• 2.5 Immediate Feedback

Criterion 9: Multiple Indicators of Successful Installation

fi The redesigned interconnector will provide a combination of visual, audible, and tactile feedback indicating a leak-tight connection between adjacent elements has been achieved upon installation.

• 2.6 Reduced Permeate Pressure Drop

Criterion 10: Elimination of Flow Restrictions

fi Internal couplers and vessel adapters account for more than 70 percent of the permeate tube pressure drop in some systems. Eliminating these restrictions will impose less permeate backpressure, reducing the feed pressure and improving system efficiency.

• 2.7 Robust Mechanical Design

Criterion 11: Cantilever Load Capability

fi During installation, an element may be momentarily supported by its connection to a second element already installed and protruding from the vessel. The strength of the components will substantially exceed the loadings anticipated in this cantilever situation. A safety factor of 2 was targeted, where by the connection must with standat least twice the bending moment imposed by a wet element supported as shown in Figure 1.

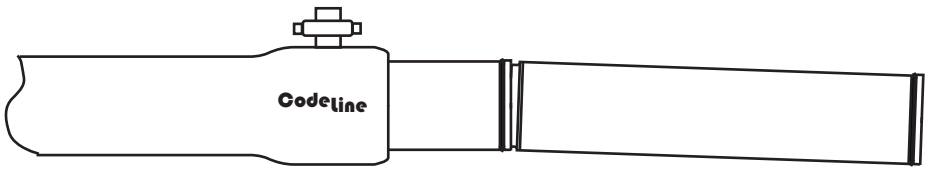


Figura 1

Figure 1

Criterio 12: Assoluta tenuta degli interconnettori finali

- Gli interconnettori tappo-membrana, sono stati progettati contro eventuali scollamenti o spostamenti dalla sede del tappo.

Criterio 13: Duata nel tempo anche per applicazioni ripetute

fi Ripetute installazioni, come può avvenire per esempio quando le membrane vengono smontate per i lavaggi chimici, non degradano o usurano il connettore iLEC™

Criterio 14: Integrità di tenuta anche con flessione del vessel

fi L' integrità di tenuta tra membrana e membrana sul tubo del permeato , viene garantita anche con l' abbassamento o la flessione del vessel,come illustrato in figura 2.

Criterion 12: Absolute Endcap Retention

- The redesigned interconnector will solve an existing problem whereby end caps may come loose from the element.

Criterion 13: Durability with Repeated Installation

fi Repeated installation cycles, as may occur when the elements are frequently removed for cleaning, will not degrade interconnector performance.

Criterion 14: Seal Integrity Inside a Sagging Vessel

fi The permeate connection between elements will not leak as a result of deflections induced by a sagging pressure vessel. The bending deflection is shown in Figure 2.

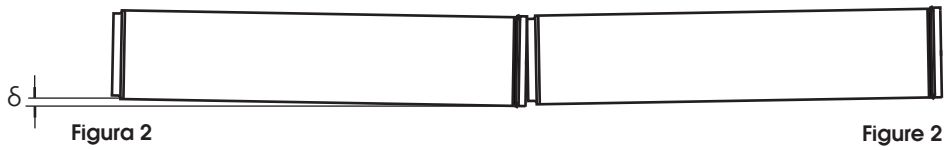


Figura 2

Figure 2

Criterio 15: Capacità di funzionamento ad alte pressioni

fi La pressione applicata in alimento, induce a pedite dagli o-ring proporzionali alle perdite di carico. Per la progettazione di iLEC™ è stato considerato un fattore di sicurezza non inferiore a 2

2.8 Semplicita di installazione e di sostituzione

Criterio 16: Minori sforzi, minor tempo e minor personale

fi La fase di installazione e sostituzione delle membrane è generalmente effettuata da almeno due persone. Il tempo richiesto per queste operazioni dipende dalla facilità di accesso ai moduli osmotici, dalla forza impiegata per l' estrazione delle membrane, dalla lubrificazione e dalla cura avuta sull' inserimento degli interconnettori. Con il nuovo sistema iLEC™ i tempi operativi verranno agevolati e ridotti sensibilmente. In più lo sforzo richiesto da un solo individuo per le operazioni di installazione e sostituzione, sarà sicuramente inferiore e

Criterion 15: High Pressure Capability

fi The feed water pressure required to induce seal leakage will exceed that encountered in actual service by a factor of at least 2.

2.8 Easy Loading and Unloading

Criterion 16: No Increase in Time, Personnel, or Effort

fi Element loading and unloading is typically carried out by a team of two individuals. The time required for these operations varies widely, depending upon the accessibility of the vessel in question, the force required to slide the elements, the lubrication protocol, and the care taken during insertion of the couplers. When compared under similar circumstances, the redesigned interconnector will require no additional time or personnel for such operations. Furthermore, the effort required by an individual to connect the elements, one to the next, will be equal or

comunque non superiore a quello profuso con moduli standard.

III. Progettazione razionalizzata

3.1O-ring: assiali o radiali?

La progettazione si è focalizzata prima su quale fosse il tipo di tenuta migliore. In base all' esperienza maturata e facendo riferimento alle applicazioni industriali con più elementi interconnessi tra loro, si sono identificati tre tipi di tenute illustrate nella tabella 1. La configurazione di tenuta più diffusa e applicata è quella radiale. Tuttavia si può notare che essa soddisfa minimamente i 7 punti posti come obbiettivo. Come infatti si evince dalla tabella 1, l' applicazione radiale migliora sì la tenuta meccanica, previene le abrasioni e protegge la superficie di appoggio, tuttavia la configurazione assiale è molto più performante e risponde positivamente a tutti i 7 criteri della tabella.

Table 1. Criteri di valutazione rivolti ai vari metodi di interconnessione

diminished.

III. Design Rationale

3.1 Compressible Seals: Axial or Radial?

The design process focused first upon the intended method of sealing. The objective to choose among familiar industrial seal configurations the best option for connecting elements in series. Three candidate seal configurations were identified, as shown in Table 1. The method currently in widespread use, the sliding radial seal, is shown to satisfy few of the first seven design criteria. As noted in Table 1, the radial seal is improved if mechanically restrained or fixed to prevent relative movement of the elements after installation. This eliminates abrasion during extended operation.

The third configuration, the fixed axial seal, complies with all seven criteria.

Table 1. Evaluation of various methods of sealing using design criteria

Tipo di o-ring/Type of seal

Criterio di progetto/Design Criteria	Radiale Radial		Assiale Axial
	Scorevole Sliding	Fisso Fixed	Fisso Fixed
1. Permette l' utilizzo di un numero minore di o-ring/Permits reduction in number of seals	☺	☺	☺
2. Fornisce una precisa tenuta con forza di compressione/Provides precise seal compression			☺
3. Previene le abrasioni/Prevents abrasion		☺	☺
4. Sfrutta le forze indotte dal flusso/Utilizes flow-induced forces			☺
5. Evita i pizzichii e i rolii/Precludes pinching or rolling			☺
6. Protegge la superficie di tenuta/Permits protection of sealing surfaces	☺	☺	☺
7. Riduce l' utilizzo di lubrificanti/Reduces reliance on lubricants			☺

Meno superficie di tenuta

- L' o-ring assiale bloccato, riduce del cinquanta per cento il rischio di potenziali perdite, confidando sull' utilizzo di un solo o-ring per elemento anzichè due che, come i sistemi attuali, lavorano in parallelo.

Compressione precisa

fi Con l' o-ring assiale, la profondità della sede di tenuta, può essere utilizzata progettualmente per stabilire con estrema precisione qual' è il limite massimo di compressione dell' o-ring. La deformazione della tenuta (da estremo ad estremo), sarebbe minore di 0.5 mil (0.0005 inch, o 0.013 mm). La stessa precisione non è ottenibile con la fabbricazione del tubo del permeato (sia come diametro interno che esterno), anche se il tubo viene secondariamente lavorato per lenire le tolleranze. Un tubo che viene chiuso ermeticamente con un diametro che varia di 5 mils (0.013 mm) da parte a parte, causa nell' o-ring radiale una compressione quantificabile in 2.5 mils. (0.007 mm). Questi risultati possono sembrare insignificanti, ma proviamo ad immaginare i nostri calcoli su una sezione di ornig di 100 mil (0.26 mm)

Eliminazione dei rischi dovuti alle abrasioni

fi Il vantaggio di una tenuta assiale, è quello di aderire sulla superficie di appoggio con movimenti minimi, cosa che non

Fewer Seals

fi The fixed axial seal achieves a fifty percent reduction in the number of potential leak points by relying on a single seal between elements, rather than the current two seals acting in parallel.

Precise Seal Compression

fi For the axial seal, the depth of the o-ring groove can be used to establish the amount of seal compression with a high degree of precision and accuracy. The part-to-part variation for this feature would be less than 0.5 mil (0.0005 inch, or 0.013 mm) when injection molded. The same precision is not obtained for the machined inner or outer diameter of a permeate tube, even when the tolerances are improved by secondary machining.

A tightly-toleranced tube with a diameter that varies by as much as 5 mils from part to part would cause variation in radial seal compression of 2.5 mils. This small number accounts for 10 percent of the nominal compression if the seal is squeezed by 25 mils, as might be expected in the case of an o-ring with a 100-mil cross-section.

Elimination of Seal Abrasion

fi A key benefit of the axially-compressed seal is that it precludes relative movement of the sealing surfaces. O-ring wear is

avviene con un normale o-ring radiale. Gli effetti del rollio di un o-ring scarsamente lubrificato sono fisibili nella figura 3. Questa problematica porta ad una cattiva tenuta.

eliminated. Evidence of a poorly lubricated, sliding o-ring is shown in Figure 3. This seal failed due to a gradual loss of o-ring compression.

Figure 3: Usura di o-ring causata da cattiva lubrificazione all' interno del tubo produzione permeato

Figure 3: Evidence of o-ring wear inside a product water tube due to insufficient lubrication of the sliding seal.

Utilizzo con variazione di flussi e pressione

fi In un vessel 8 pollici di diametro da 7 elementi in assenza o breve presenza di fouling, il carico a valle tra gli elementi e la fine del vessel è generalmente di 136 kg, mentre a monte tra gli elementi e la loro fine è di 544 kg. Questo carico viene trasmesso attraverso i tappi e le tenute delle membrane. Queste ultime svolgono un ruolo chiave e primario poichè i carichi da sopportare come si può pensare sono veramente importanti.

Nessun problema di rollio o di pizzicamento.

fi La tenuta assiale non è coinvolta in nessun movimento che possa portare al suo rollio o pizzicamento.

Operazioni senza lubrificanti

fi Per le applicazioni assiali su fluidi, i lubrificanti non vengono generalmente utilizzati, a meno che non si voglia facilitare l' inserimento dell' o-ring all' interno della sede di tenuta o proteggerlo da un ambiente particolarmente critico. Sull' analisi di quanto appena detto, il concetto di o-ring assiale è stato studiato per portare rapidità di interconnessione con un sistema sicuro e all' avanguardia. La scelta della tenuta assiale assicura quindi una connessione meccanica molto fluida dal primo elemento montato fino all' ultimo.

3.2 Connessione meccanica: assiale, radiale o rotazionale?

Per poter analizzare le potenzialità della connessione meccanica, questa la si è divisa in tre possibili applicazioni dipendenti dalla direzione del movimento una volta interconnessi gli elementi tra di loro.

La connessione assiale, visibile in figura 4 (a), viene effettuata con una spinta diretta verso il modulo da interconnettere, riprendendo lo stesso principio già utilizzato per l' inserimento di una spina di corrente o la chiusura a scatto di certe bottiglie.

La connessione radiale (b), comporta un moto scorrevole perpendicolare all'asse dei componenti collegati.

La connessione rotazionale, si basa invece sul concetto di interconnessione ad intreccio (tipo collegamento di fili elettrici).

Il collegamento radiale fu il primo ad essere scartato in quanto non compatibile con i modelli e le applicazioni degli elementi già in commercio.

Il collegamento assiale, anche se possedeva tutte le caratteristiche per poter lavorare su una tenuta piatta, non poteva essere praticato appieno in quanto la forza di spinta per interconnettere i moduli, doveva essere tanto maggiore quanto maggiore era l' esigenza di tenuta.

Tutto questo comporta all' installatore sforzi maggiori e difficoltà di equilibrio quando i moduli vengono inseriti all' interno del vessel, senza contare le sollecitazioni meccaniche alle quali i moduli sono sottoposti.

Si è arrivati quindi a scegliere un' interconnesione rotazionale in abbinamento ad una tenuta assiale come base per la realizzazione di un interconnettore unico e all' avanguardia.

Utilization of Flow-Induced Forces

fi In an 8-inch pressure vessel containing seven 40-inch elements with little or no fouling, a typical compressive load might be 300 pounds (136 kg) between elements at the upstream end of the vessel and 1200 pounds between elements at the downstream end. This load is transmitted through the endcaps, complementing the sealing force imposed by the endcap locking action.

No Pinching or Rolling

fi The axial seal requires none of the relative movement that might pinch or roll the o-ring from its groove during installation.

Lubricant-Free Operation

fi Lubricants are generally not required for static, axially-compressed seals in liquid applications, unless desired to ease installation of the o-ring into the groove or to protect the o-ring from a particularly harsh environment.

Based upon the analysis just summarized, the fixed axial seal concept was selected for further development. Its selection required consideration of a means of mechanically connecting the elements, one to the next, so as to initiate and maintain the fluid-tight seal.

3.2 Mechanical Connections: Axial, Radial, or Rotational?

Potential connection concepts were sorted into three groups, depending upon the direction of movement when joining elements. The axial connection, shown in Figure 4 (a), uses the same push-on approach found in applications ranging from electrical receptacles to snap-on lids for plastic bottles. The radial connection (b) involves a sliding motion perpendicular to the axis of the connected components. The rotational connection (c) encompasses threads and other interlocking concepts relying on relative rotation. Concepts involving additional parts such as band clamps and fasteners were avoided. The radial connection was the first to be discarded because it does not lend it self to backward compatibility with the standard sliding coupler. If the radial connection is left un-made for the purpose of inserting a coupler, then protruding endcap features cause the effective length of the element stack to increase. The axial connection was also viewed less favorably when the need to compress an axial seal upon installation was considered. The manually-applied force needed to make the connection increases in proportion to the amount of compression desired. Furthermore, if the connection involves a snapping-together of the elements, then the need for sufficient cantilever load capability imposes a still higher force threshold for the installer. The axial connection does not readily combine ease-of-installation with other interconnector requirements. These and other arguments drove selection of the rotational connection, in combination with the axial seal, as the basis for an improved interconnector.

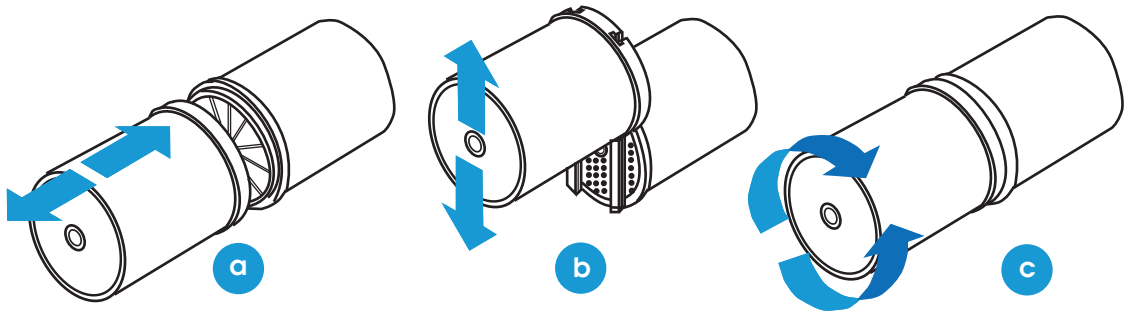


Figura 4: Tre esempi di interconnessione meccanica tra elementi (a) Assiale; (b) Radiale; (c) Rotazionale.

Figure 4: Representative examples of three methods of mechanical interconnection.(a) Axial; (b) Radial; (c) Rotational.

3.3 Progettazione e configurazione delle connessioni
I prototipi che hanno portato alla realizzazione dell' innovativo sistema di interconnessione iLEC™ sono illustrati in figura 5. La parte terminale del modulo (downstream endcap) si adagia nella parte iniziale del modulo successivo (upstream endcap) il quale è fornito di un o-ring assiale per tenere separato il flusso del concentrato da quello del permeato. Questo flusso è illustrato nella figura 6b. Ciascun elemento viene interconnesso direttamente con l' altro tramite il tappo terminale, e ognuno di essi garantisce sia la tenuta meccanica che la compressione dell' o-ring assiale, il tutto in un unico blocco che va dal primo fino all' ultimo elemento. I tappi terminali sono realizzati in ABS, un materiale comunemente utilizzato per queste applicazioni. La sede dell' o-ring sul tappo viene realizzata con un processo successivo utilizzando adesivi, solventi, e altri materiali di saldatura per garantire il massimo dello standard produttivo. Infine ogni tappo viene testato separatamento con prove di vuoto per garantire la massima tenuta.

3.3 Design Configuration of the Interlocking Endcap
Prototypes with the improved design are shown in Figure 5. The smaller downstream endcap nests inside the larger upstream endcap, which holds a single axially-compressed o-ring for sealing between the concentrate and permeate. This arrangement is diagrammed in Figure 6b. Interlocking tabs around the periphery of each endcap provide a fixed mechanical connection between elements, compressing the o-ring upon installation and maintaining a tight seal there after. The injection-molded prototype endcaps are made from ABS plastic, a materialal ready in widespread use for such parts. Because the o-ring seal resides on the endcap, a leak-tight connection between the permeate tube and endcap is required. Processes involving adhesives, solvents, and various means of welding are available to create this connection. Vacuum testing of every tube-endcap connection, in isolation from the rest of the element, is carried out after attachment to insure complete reliability.

Figura 5: sistema iLEC™ con o-ring compresso a tenuta assiale

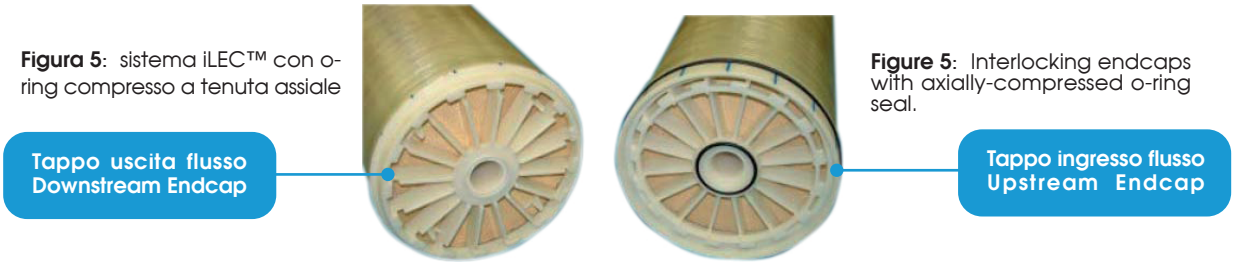


Figure 5: Interlocking endcaps with axially-compressed o-ring seal.

Protezione della superficie di tenuta
- Le superfici di tenuta degli o-ring assiali, non vengono a contatto con terra, utensili, arnesi e altri accessori tipicamente utilizzati per le installazioni. Per la chiusura dei moduli all' interno del vessel, sono previsti due tappi (uno iniziale e uno terminale) Quelli iniziali hanno un incavo per l' allogiamento dell' oring, mentre quelli terminali sono dotati di una superficie di appoggio sempre per la tenuta dell' o-ring assiale. Questi due tappi sono simili ai tappi utilizzati negli elementi attuali e il tappo finale è dotato di un o-ring assiale già premontato

Compatibilità con le versioni precedenti
fi Per quanto riguarda l' adattabilità all' interno del vessel, la compatibilità con i moduli in commercio viene mantenuta totalmente. Il foro di deflusso del permeato non è cambiato consentendo l' inserimento di adapter per la giunzione col vessel. La lunghezza netta dei moduli, quando interconnessi, rimane di 40" (1016 mm). L' avvenuta interconnessione tra moduli è riscontrabile sia visivamente che acusticamente nella parte terminale della 1^ membrana e nella parte iniziale della 2^, tramite incavi e linquette che permettono una connessione a "baionetta". Una volta che i moduli sono agganciati, non ci sono più pericoli che questi si sgancino o si disiallineino, grazie al perfetto meccanismo a "baionetta".

Protected sealing surfaces
- The critical surfaces of the axial seals are recessed away from those parts of the endcap that make first contact with the ground, push rods, tools and other objects.
Together with the need for retention of the o-ring upon disengagement of the elements, this required dissimilar element endcaps fi one with a groove for o-ring retention, and one with a flat surface opposing the groove. The use of dissimilar endcaps is not new in so far as current element configurations rely upon a brine seal installed at one end of the element.

Backward Compatibility
fi Compatibility with existing hardware is maintained. The smooth inner bore located at each end of the permeate tube is unchanged, which permits insertion of sliding couplers and vessel adapters. The net length of the elements, when connected, remains 40 inches (101.6 cm). Immediate Installation Feedback fi The interlocking endcap relies upon four radially-deflected tabs on the downstream endcap to provide tactile and audible feedback. These move up and over protrusions on the upstream endcap, snapping into place when the elements are fully locked together. Because the deflecting tabs are not load bearing, there is no danger of relaxation of the locking mechanism resulting in disengagement of the

L' allineamento tra membrane è visualmente riscontrabile sull' orlo di ciascun tappo terminale del modulo, tramite dei segni appositi pre stampati.

elements during operation. Rotational alignment markings on the rim of each endcap provide a visual verification of the connection.

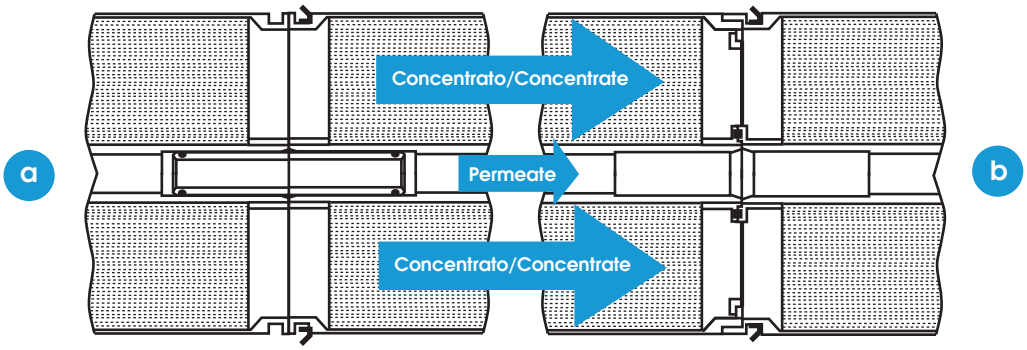


Figure 6: Confronto tra due interconnessioni sezionate. La figura (a) rappresenta un interconnettore standard ad inserto, la figura (b) il nuovo sistema iLEC™.

Figure 6: Comparison of cross-sections through the connection interface between two elements.(a) Standard sliding coupler, (b) Interlocking endcaps

IV. Prove di laboratorio e valutazioni sul campo

Questo rapporto è stato scritto riferendosi a test effettuati sull' interconnesione iLEC™ in riferimento a cinque esperimenti fatti sul campo su impianto acqua mare per uso potabile, su trattamento di acqua di superficie per utilizzo industriale e su produzione di acqua ultra pura per l' industria di semiconduttori. In tutti e cinque i casi non si sono riscontrati problemi; verranno discussi brevemente di seguito tre dei cinque casi.

4.1 Integrità della tenuta assiale a lungo termine

Sei elementi interconnessi tra loro con il sistema iLEC™ in un impianto a Freeport in Texas, che produce acqua ultra pura da una sorgente di superfice con alti problemi di sporcamento. L' impianto è stato realizzato e condotto dalla società US Filter per conto della società Veolia Environment. Le membrane sono state messe in servizio nel Marzo del 2002 e sono state inserite nel primo dei due stadi con una pressione oscillante tra i 9.0 e i 16.5 bar (130 e 240 psi) in relazione alla temperatura.Le membrane sono state rimosse dalle tre alle quattro volte all' anno per effettuare dei lavaggi chimici fuori sede. Una comparazione eseguita tra la conducibilità prodotta dai vessel contenenti le iLEC™ e altri sei elementi, ha mostrato che non ci sono state perdite. Le membrane iLEC™ continuano ad operare con successo.

Nell' Aprile del 2002, più di dodici elementi iLEC™ sono stati interconnessi tra loro in un impianto Municipale a San Pedro, Belize, per trattare acqua di mare. Il sistema RO è stato installato e condotto dalla società Consolidated Water Company, Ltd. delle Isole Cayman. Le membrane sono state inserite all' interno di due vessels disposti in parallelo in un unico stadio alla pressione di circa 60 bar (870 psi). L' impianto viene spento due volte al giorno come da richiesta del committente. I test periodici sulla conducibilità non hanno rilevato nessuna pedita sui moduli iLEC™ e ad oggi essi continuano ad operare con successo. La terza installazione è stata completata nel Marzo del 2003 in un impianto dell' INALSA sull' isola Lanzarote in Spagna. Dodici elementi iLEC™ sono stati inseriti in due vessels di cui uno posizionato al primo stadio e l' altro sul secondo stadio, alimentati con una pressione di 63 bar (920 psi). Dopo due giorni di funzionamento, il primo stadio produceva un recupero del 34% a 21°C con 38,500 mg/l di TDS. Il sesto elemento in serie operava ad un flusso medio di 20 lmh 12.0 (gfd) e produceva acqua ad una conducibilità di 180 ømho/cm (95 mg/l TDS). Il test prolungato ha riscontrato una reiezione del 99.85% e una perfetta tenuta tra le membrane.

4.2 Piccole fughe dovute all' aviamento

Nel giro di sei mesi, gli elementi iLEC™ utilizzati nell' impianto in Freeport, Texas, sono stati ripetutamente rimossi e reinstallati. L' obiettivo era quello di ricercare eventuali anomalie sulla tenuta degli o-ring.

IV. Laboratory And Field Trial Evaluation

At the time this report was written, validation of the interlocking endcap was on going at five field trial sites involving the conversion of seawater for potable use, the treatment of surface water for industrial feed, and the production of ultra pure water for semiconductor fabrication. Trouble-free operation has been verified in all five cases; results for three of the trials will be briefly discussed.

4.1 Long-Term Seal Integrity

Six interlocking elements were installed into a plant in Freeport, Texas, that produces high-quality industrial feed water from a high-fouling surface source. The plant is owned and operated by US Filter, a Veolia Environment company. The elements were put into service in March, 2002. They reside in the first stage of a two-stage system operating at 130 to 240 psi (9.0 to16.5 bar), depending upon feed temperature. The elements are removed three to four times per year for off-site cleaning. An ongoing comparison between the vessel permeate conductivities for the interlocking elements and six control elements has shown no leaks among either group. The elements continue to operate successfully.

Twelve more interlocking elements were installed into a municipal seawater RO system in San Pedro, Belize, in April, 2002. The system is owned and operated by the Consolidated Water Company, Ltd., of the Cayman Islands. The elements were placed in two side-by-side vessels within a single-stage array operating at a feed pressure of approximately 870 psi. (60bar) The system is shut down twice per day, as dictated by demand. Periodic probing of the vessels has revealed no leaks among the interlocking connections. The elements continue to operate successfully.

A third installation, involving two vessels containing a combined twelve interlocking seawater elements, was completed in March, 2003, at the INALSA plant on the island of Lanzarote, Spain. The vessels are located in both the first and second stages of a train with a feed pressure of 920 psi (63 bar). Two days after startup, the first stage provided 34 percent recovery of a 21°C feed having 38,500 mg/l of total dissolved solids (TDS). The six elements in series operated at an average flux of 12.0 gfd (20 lmh) and produced water with a conductivity of 180 ømho/cm (95 mg/l TDS). Sustained performance at this level requires standard-test rejection of 99.85 percent and perfect sealing between elements.

4.2 Leak-Tight Startup Performance

Over the course of six months, the interlocking elements in the Freeport, Texas, industrial feed water system were repeatedly removed and re-installed. The objective was to identify installation-related seal failures. Just before and after each

Prima dell' installazione e immediatamente dopo, veniva misurata la conducibilità con strumenti sensibilissimi poichè il range dell' acqua di alimento era compreso tra i 450 ai 750 ømho/cm e il permeato al di sotto dei 10 ømho/cm. La conducibilità di ogni vessel è illustrata in figura 7. In tutti i dodoci esempi, non si sono evidenziate fughe dai vessels come invece ci si aspettava per ripetute installazioni.

reinstallation cycle, the vessel conductivities were noted. The measurement was highly sensitive to leakage, with feed conductivities in the range of 450 to 750 ømho/cm and permeate conductivities below 10 ømho/cm.
The individual vessel conductivities are shown in Figure 7. In all twelve instances, no evidence of leakage was found and the elements performed as expected upon repeated re-installation.

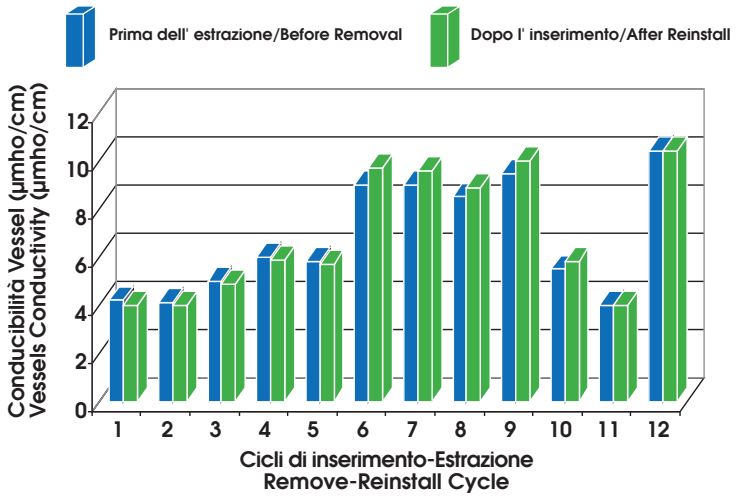


Figura 7: Conducibilità permeato prima dell' estrazione e dopo l' inserimento

Figure 7: Vessel permeate conductivities, immediately before and after removal and re-installation

4.3 Applicazioni senza lubrificante
Un tappo iLEC™ è stato immerso in acqua con l' o-ring assiale senza alcun lubrificante e gli è stato applicato una pressione esterna di 138 bar (2000 psi) per 14 giorni. Prima del test una piccola quantità di assorbente è stata inserita all' interno della piccola cavità del tappo. La massa di assorbente, dopo 14 giorni, non è cambiata, mostrando la perfetta tenuta anche senza l' utilizzo di lubrificanti.

4.4 Compatibilità
Valutazioni sul campo e test di laboratorio hanno mostrato che il sistema iLEC™ è compatibili sia con gli attuali adattatori Filmtec che con gli quelli prodotti ed utilizzati dai più importanti produttori di vessels Europei e Nord Americani. Mentre la verifica dei maggiori produttori di vessels è ancora in corso, ad oggi non si sono riscontrate incompatibilità.

4.5 Immediato riscontro dell' avvenuta interconnessione
L' avvenuta connessione sui tappi terminali delle membrane iLEC™, è facilmente riscontrabile tramite un indicatore uditivo, tattile e visivo. Questa importantissima caratteristica, viene fornita all' installatore per dare chiara informazione dello stato dell' interconnessione, anche operando in condizioni difficili di rumore, utilizzo di guanti protettivi ecc.

4.6 Riduzione delle perdite di carico

4.6.1 Eliminazione delle restrizioni di flusso
fi Lo scivolamento dell' adapter come quello illustrato in figura 6, o lo scivolamento di adapter simili, provocano una perdita di carico.
Si sono fatti test di laboratorio complessi su queste perdite di carico indotte, poichè anche test sul campo si sono rilevati molto approssimativi. Per i test di laboratorio, si è costruito un vessel virtuale formato da diversi tubi di permeato agganciati in serie. In flusso è stato fatto entrare all' interno dei tubi per una lunghezza di 40" per simulare la lunghezza di un vessel standard. La pressione è stata misurata sia a valle di ciascun tubo che sull' adapter del vessel tramite l' utilizzo di un trasduttore di pressione. I primi tre tubi del permeato di questo gruppo di test è mostrato in figura 8. Le perdite di carico sono state misurate a diverse portate e con interconnettori differenti, utilizzando

4.3 Lubricant-Free Operation
An interlocking endcap connection using a lubricant-free o-ring was submerged in water and externally pressurized to 2000 psi (138 bar) for 14 days. Prior to the test, a small quantity of absorbent was placed inside the small, protected cavity formed by the connected endcaps. The absorbent mass after 14 days was unchanged, demonstrating the fluid-tightness of the lubricant-free o-ring.

4.4 Backward Compatibility
Field and laboratory evaluations have shown the interlocking elements to be compatible with current FilmTec couplers along with the vessel adapters supplied by various North American and European manufacturers. While the verification with respect to additional vessel suppliers is ongoing, no cases of incompatibility have yet been identified.

4.5 Immediate Installation Feedback
The interlocking endcap provides an audible, tactile and visual indication of a successful connection. These complementary features were shown to provide the installer with clear information as to the state of the connection, in spite of potential interferences from the noise of an operating plant and the use of gloves during installation.

4.6 Reduced Permeate Pressure Drop

4.6.1 Elimination of Flow Restrictions
fi Sliding internal couplers like the one shown in Figure 6, together with similarly-configured vessel adapters, impose unintended permeate pressure loss. The present effort involved an experimental evaluation of those losses, although standard engineering texts were found to be useful for obtaining an approximate result. For the laboratory setup, a virtual vessel was simulated using several jacketed permeate tubes connected in series. The flow entering each 40-inch long tube via the side-holes was controlled to mimic the contribution of an element in operation. The pressure was measured at the downstream end of each tube, and also on the outlet side of the vessel adapter, using a digital pressure transducer. The first three permeate tubes in this simulated stack of elements are shown in Figure 8. Pressure drops were measured at a variety of flowrates

anche quelli per alte pressioni che hanno un diametro di passaggio inferiore. I parametri geometrici vengono illustrati nella tabella 2.
I flussi prodotti dagli elementi virtuali decrescono man mano che si allunga la via del permeato (diminuzione di flusso verso valle).
Il flusso di attraversameto nei tubi del permeato è stato espresso in termini di flusso medio in galloni per square foot per giorno (gfd), assumendo un' area attiva filtrante per la membrana di 380 square feet (35 m2). I risultati dell' esperimento vengono ben illustrati in figura 10.
Si sono potute redigere tre tabelle ognua utilizzando tre tipi di adapter (coupler) differenti che variano in base al loro diametro interno (quelli con diametro più piccolo vengono utilizzati su pressioni di alimento maggiori).
Di ciascuna tabella si sono misurate le perdite di carico dovute alla restrizione di flusso apportata dagli adapter, ciscuna suddivisa per moduli da 6 element e da 8 elementi posti in serie. Le misurazioni sono state effettuate a tre flussi differenti. La tabella denominata "Interlocking end cup" è stata redatta utilizzando connettori finali come quelli illustrati in figura 9.

using two different sliding couplers. One coupler was designed for higher pressure and had a smaller inside diameter. Also simulated were the interlocking endcaps, for which the sliding couplers were simply omitted. Geometrical parameters for these configurations are summarized in Table 2. The flow contributions of the virtual elements decreased from one element to the next in the downstream direction. By this method, a permeate outlet located opposite the feed end of the vessel was simulated. The vessel-average flow rate during a given run was expressed in terms of the average flux, in gallons per square foot per day (gfd), assuming an active membrane area of 380 square feet (35 m2). The experimental results are presented in Figure 10. The charts permit interpolation of pressure drops for intermediate flux schedules, intermediate coupler diameters, and six to eight elements in series. The pressure drop contribution of the downstream vessel adapter is evident in the non-zero backpressure at the outlet of the last element. The inside diameters of the adapters were similar to those of the corresponding couplers described in Table 2. An alternative adapter design utilizing the interlocking endcap is shown in Figure 9.

Figure 8:
Impianto pilota per la misurazione delle perdite di carico sul tubo del permeato.
Apparatus for measurement of permeate pressure drop in product water tubes and couplers.

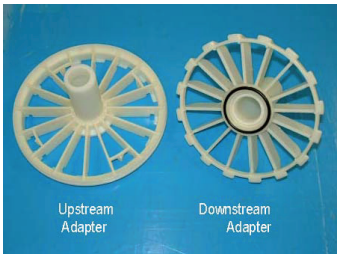


Figure 9:
Adattatori iLEC™
Interlocking vessel adapters.

Tabella 2: diametro interno adapter per valutazione delle perdite di carico sul permeato
Table 2: Inside Diameter of Components Evaluated for Permeate Pressure Drop

Componenti/Component	Diametro interno pollici (mm) Inside Diameterinches (mm)
Tubo permeato/Product Water Tube	1.00 (25.4)
Adattatore bassa pressione/Low-pressure Coupler	0.81 (20.6)
Adattatore alta pressinione/High-pressure Coupler	0.69 (17.5)

Il diametro interno del tubo del permeato da 1", permette un passaggio ottimale del permeato, sia al vessel che verso l' uscita. Come illustrato nel grafico sotto, le perdite di carico prodotte dagli "Interlocking end cup" si sono mostrate di gran lunga inferiori a quelle prodotte dagli adapter standard. I risultati di laboratorio, sono stati successivamente confutati da numerose misurazioni sul campo in impianti funzionanti ed operativi, con sonde appropriate ad altissima sensibilità e da trasduttori di pressione.

The 1-inch inside diameter of the permeate tube is maintained through the adapter, which permits a more optimal transition to the permeate port and exterior permeate piping. If that pipe is Schedule 40 1-inch NPT, for example, then its inside diameter is 1.03 inches (26 mm). As shown in charts below, the pressure drop for the interlocking adapters was generally too low to measure accurately with the current apparatus. The lab results were corroborated by actual operating data, collected in the field with a combined permeate probe and pressure transducer.

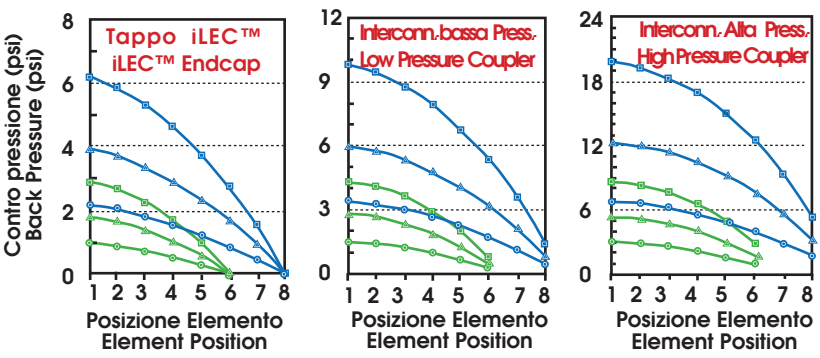


Figure 10: Contropressione del permeato dovuta ad elementi posizionati in serie. La contropressione è stata calcolata supponendo un area della membrana di 380 square foot con velocità di flusso come da legenda. Il tubo del permeato ha un diametro interno di 1"
Permeate backpressure for elements in series. Backpressures assume 380 square foot elements with flux profiles characterized by the average fluxes noted in the legend. Product water tube of 1-inch inside diameter.

4.7 Meccanica rafforzata ed irrobustita

4.7.1 Capacità di carico

fi Tre coppie di membrane iLEC™ sono state prese in esame per i test (vedi figura 11). Si è proceduto a bolccare un elemento con due supporti imbottiti dalla larghezza di 3" posti ciascuno alla distanza di 6" dalla fine della membrana. Si è proceduto quindi a misurare il δ prodotto sull' estremità della seconda membrana incrementando di volta in volta il carico di 10 pound (4,5 kg). L' elemento era in forma dry (asciutta) e pesava 25 pounds (11,3 kg).

4.7 Robust Mechanical Design

4.7.1 Cantilever Load Capability

fi Three pairs of interlocking elements were tested in cantilever mode as shown in Figure11. The braced element was supported with two 3 inch-wide padded supports located 6 inches from the ends of the element. The displacement at the tip of the second element, δ, was measured at each 10-pound increment of applied load. The cantilevered element was dry and weighed 25 pounds.

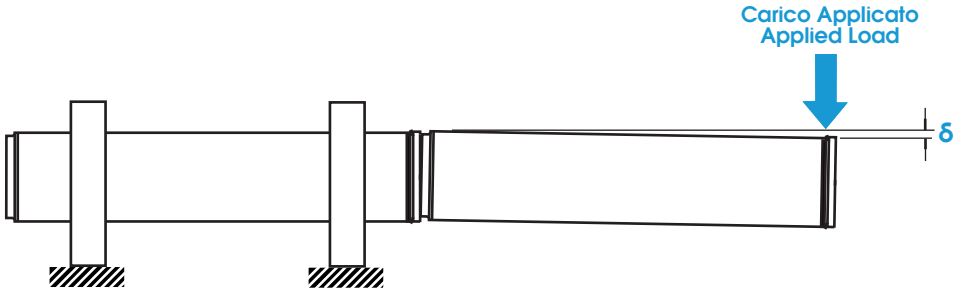


Figura 11: Test di carico

Figure 11: Configuration of Cantilever Test

Per ciascuna coppia di membrane, il test si è fermato nel momento in cui la parte di congiunzione tra i tappi finali e la vetroresina inziava a rompersi. Il δ medio riscontrato sulle membrane è stato di 1,26 pollici (32 mm) con un carico (il più basso dei tre) di 39 pounds (17.5 kg). Il momento flettente corrispondente sul carico medio è stato di 185 ft-lb che è 2.9 volte il momento indotto da una membrana in forma wet (umida) dal peso di 38 pounds (17.1 kg). Questa robustezza è superiore al fattore di sicurezza 2.0 posto come obiettivo.

4.7.2 Assoluta tenuta degli interconnettori finali

- Tre membrane iLEC™ sono state testate separatamente ponendole in trazione tramite un macchinario testato (Tinius Olsen Universal Testing Machine). Il carico di trazione è stato applicato sui due tappi estremi della membrana con l' intento di strapparne uno dei duei.

For each pair of elements, the test was stopped shortly after the fiberglass on either element fractured at its junction with the endcap. The average deflection at failure was 1.26 inches. The average load was 43 pounds, and the lowest of the three was 39 pounds.

The bending moment corresponding to the average load was 185 ft-lb, which is 2.9 times the moment induced by a wet element weighing 38 pounds. This strength multiple substantially exceeds the original factor-of-safety goal of 2.0.

4.7.2 Absolute Endcap Retention

fi Three interlocking elements were tested separately under tension conditions using a Tinius Olsen Universal Testing Machine. Tensile load was applied to the element by gripping the endcaps at either end, where by the force required to remove one of the endcaps was determined.

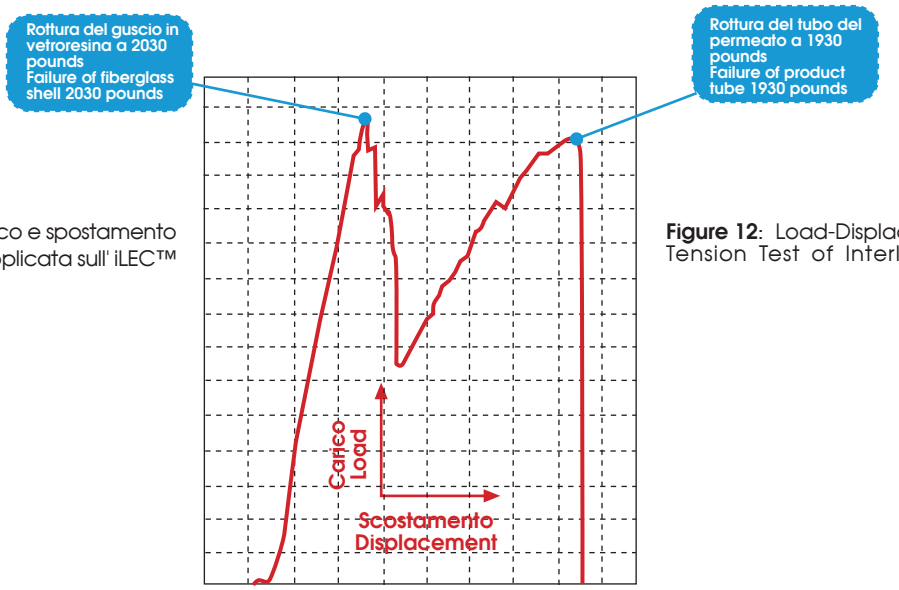


Figure 12: Curva di carico e spostamento dovuta alla tensione applicata sull' iLEC™

Figure 12: Load-Displacement Curve for Tension Test of Interlocking Element

L' elemento ha iniziato a cedere a 1905 pounds per rompersi definivamente a 1990 pounds (864-903 kg), di gran lunga lontano dal carico di trazione prodotto da un essere umano durante le operazioni di estrazione dal vessel. Due delle tre membrane testate, si sono rotte per causa della fuoriuscita del tubo del permeato, mentre nella terza si sono strappati i tappi terminali. In tutti e tre i test, la parte della membrana che ha iniziato a

The elements failed at 1905 to 1990 pounds (864 to 903 kg), far exceeding the tensile loads that might be applied when an element is pulled, by hand, from a pressure vessel. Two of the failures occurred when the permeate tube was pulled a part in tension; the third element failed with destruction of the endcap. All three failures were preceded by failure of the fiberglass outer shell, as typified by the bimodal load-

cedere, è stata l' avvolgimento esterno della vetroresina (come illustrato in figura 12), ma nonostante ciò i tappi e il tubo del permeato hanno continuato la loro azione di resistenza. Durante le operazioni di inserimento o estrazione della membrana, nel caso estremo in cui un elemento dovesse essere sottoposto ad un carico importante di trazione, la prima parte che inizierà a rompersi sarà il guscio della vetroresina.

4.7.3 Duata nel tempo anche per applicazioni ripetute

Il punto chiave per l' applicazione del test di durata, era quello di constatare eventuali anomalie dopo ripetute interconnessioni e separazioni dei moduli iLEC™ con l' applicazione di ripetute torsioni. Per questo test sono state utilizzate 4 coppie di membrane sottoposte a 100 cicli in continuo di apertura e chiusura dell' interconnessione iLEC™. L' effetto usurante sull' interconnessione è statto misurato con uno strumento digitale che misutra il picco massimo di usura. Come si può notare dalla figura 13, l' usura ottenuta con la chiusura e l' apertura del connettore iLEC™ aumenta dal 22% al 27% durante i 100 cicli. Poiche la vita media di una membrana non potrà mai comportare così tante interconnesioni e separazioni, il declino dovuto alla torsione è stato giudicato più che accettabile.

displacement plot shown in Figure 12. While loose endcaps have been noted among elements subject to extensive handling, as may occur with repeated loading and unloading, such failures are often initiated by an impact that loosens the connection to the fiberglass shell. In such cases, the new interlocking endcap will be firmly retained by the element until the unlikely total destruction of either the tube or endcap.

4.7.3 Durability with Repeated Installation

fi The key question with respect to durability of the endcaps is their capacity to with stand repeated locking and unlocking cycles without a significant decline in the locking torque. A substantial change would signal wear of the locking features, which could lead to unintended disengagement and loss of seal capability during loading or operation. To examine durability, four pairs of endcaps were subjected to 100 lock-unlock cycles. The effect of wear upon the peak torque was recorded using a digital torque wrench with peak torque capture capability. As shown in Figure 13, the locking and unlocking torques decreased by 22% and 27%, respectively, over the course of 100 cycles. Because most elements will see no more than a few cycles over their life time, the observed torque decline was deemed acceptable.

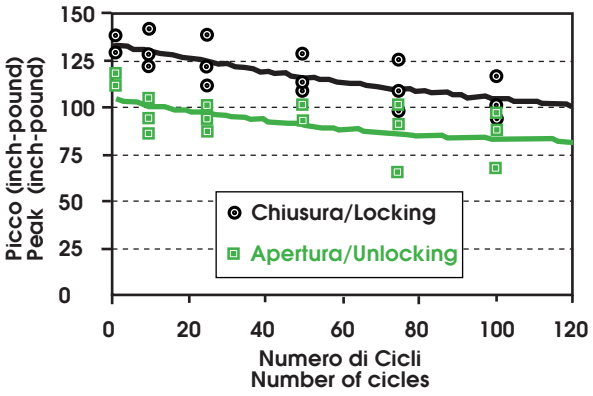


Figure 13: Misurazione dei momenti di picco di una simulazione di apertura e chiusura degli elementi
Effect of simulated installation cycles upon peak torque during locking and unlocking of elements.

4.7.4 Integrità di tenuta anche con flessione del vessel

- Due membrane da 8" di diametro e 40" di lunghezza vengono supportate sulle loro estremità e interconnesse tra di loro. Sulla loro interconnessione viene posto un carico come illustrato in figura 14. Un vacuometro di mercurio dalla lunghezza di 380 mm (15 inches) viene posto dentro il tubo del permeato, e con esso viene monitorato l' incremento di carico applicato. Le membrane hanno al loro interno dei tubi speciali chiusi sull' estremità del permeato. Questo sistema permette un' accurata misurazione delle fughe causate dagli o-ring di interconnessione delle iLEC™. La deviazione δ per una membrane in forma wet e senza nessun carico applicato era di 0.13 inches (3.3 mm).

4.7.4 Seal Integrity Inside a Sagging Vessel

fi Two interlocked 8-inch by 40-inch elements were supported at their opposite ends and a down ward load was applied at the junction as shown in Figure 14. A vacuum of 15 inches (380 mm) of mercury was applied to the permeate tubes, and the on set of leakage was monitored as the load increased.

The elements incorporated special tubes lacking side-holes for permeate flow. This allowed accurate detection of leakage at the interlocking o-ring connection. The deflection, δ, for wet elements and no applied load was 0.13 inches.

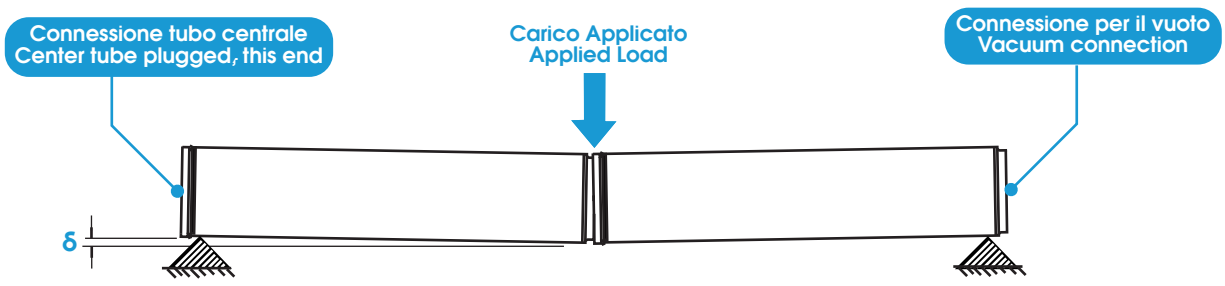


Figure 14:Test del vuoto in relazione alla flessione/Test setup for vacuum test with bending

Il massimo carico applicato è stato di 100 pounds (45 kg) con una deviazione δ di 0.44 inches (11.2 mm). Nessuna fuga di vuoto è stata riscontrata.

The maximum applied load was approximately 100 pounds, for which the deflection was 0.44 inches.
No vacuum leakage was detected.

Abbassamento del punto medio del vessel inches (mm)/ Vessel Midpoint Sag inches (mm)	Misurazione della deformazione della membrana inches (mm)/ Required Element Pair Deflection, inches (mm)
0.25 (6.4)	0.06 (1.5)
0.5 (12.7)	0.11 (2.8)
1.0 (25.4)	0.22 (5.9)
2.0 (50.8)	0.44 (11.1)

Table 3: Abbassamento del Punto medio del vessel e relativa flessione di un elemento accoppiato
Vessel Midpoint Sag and Corresponding Deflection of Individual Element Pairs

4.7.5 Capacità di funzionamento ad alte pressioni - Tre coppie di tappi iLEC™ sono stati sottoposti a pressione all' interno di un contenitore illustrato in figura 15. Per la preparazione dei campioni da testare, si sono inseriti all' interno dei tappi, dei tubi del permeato tagliati corti e fissati con materiale epossidico in modo da creare una cavità protetta tra la connessione. Ciacun campione è stato poi inserito nel contenitore e questo è stato prima riempito di acqua e poi pressurizzato. Si è aumentata gradualmente la pressione fino al punto critico di rottura. I campioni sono implosi dal tubo del permeato rispettivamente alle pressioni di 2800, 2900 e 2650 psi (193, 200, 183 bar). In tutti e tre i casi la rottura è stata isolata nella zona del tubo permeato non rilevando abrasioni negli o-ring. Come mostrato in figura 16, la rottura del tubo è prossima alla saldatura ma la saldatura è rimasta integra.

4.7.5 High Pressure Capability
fi Three pairs of interlocking endcaps were pressurized to failure inside the containment device shown in Figure 15. To prepare the samples for testing, short lengths of permeate tube were spin-welded to each endcap. These were sealed at the ends with epoxy to create a protected cavity within the connection. Each assembly was then placed in the container, which was flooded with water and pressurized. The pressure was increased gradually to the point of failure. The prepared samples failed by implosion of the permeate tube at 2800, 2950, and 2650 psi, respectively.
In all three cases, the failures occurred within the counter-bored region of the tube. There were no signs of o-ring extrusion. As shown in Figure 16, the breakage of the tube approached the weld zone, but the welded connection between endcap and tube was maintained.

Figure 15: Camera per test ad alta pressione/ Chamber for high-pressure testing of interlocking endcaps.

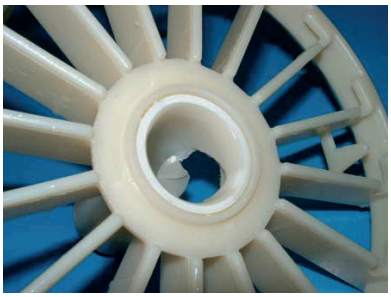


Figure 16: Rottura del tubo permeato nell' area adiacente alla connessione col tappo/
High-pressure failure of product water tube in area adjacent to weld with endcap.

4.8 Semplicita di installazione e di sostituzione
Prove sul campo hanno rilevato come il tempo di connessione e inserimento delle iLEC™ sia strettamente dipendente dalla pratica che ha l' installatore. In molti casi l' operazione può essere portata a termine in tre minuti per un vessel contenete 6 elementi. Un tempo maggiore invece (dai quindici ai venti minuti) viene richiesto per l' estrazione delle membrane e le operazioni di apertura e chiusura del vessel. Lo scarico delle iLEC™ è un' operazione particolarmente agevole in quanto i moduli possono essere spinti ed estratti dal fondo del vessel, diversamente come avviene nelle applicazioni standard dove i noduli vengono spinti con verghe ed attrezzi anche contundenti. Si è constatato che Il numero di operatori necessari alle operazioni di carico delle iLEC™, è di due persone, lo stesso numero che generalmente viene utilizzato per le membrane standard.

CONCLUSIONI
Numerose tecnologie di interconnessione sono state progettate ed applicate con successo in diversi campi. Il problema fondamentale nella progettazione di un sistema di interconnessione, è quello di rendere efficace e compatibile la tecnologia studiata con il relativo campo di applicazione. Per il progetto iLEC™ sono stati stabiliti 16 requisiti fondamentali

4.8 Easy Loading and Unloading
Field trials revealed significant variation in the time required to connect and push the interlocking elements into the vessel, depending upon local practices. In most cases the task could be carried out in less than three minutes for a six-element vessel. A far longer period of time, fifteen to twenty minutes, was required to disconnect the permeate plumbing, open the vessels, close the vessels, and reconnect the plumbing. Unloading was particularly efficient because the interlocking elements could be pulled to the downstream end of the vessel during removal. This eliminated the need for push rods incases where their use was otherwise customary. The interlocking elements were often installed by a team of two individuals, which was unchanged from the number of personnel used to load standard elements.

CONCLUSIONS
Numerous well-designed seal technologies exist and are used reliably across many demanding fields and applications. Achieving trouble free seal operation is primarily a matter of matching the appropriate seal configuration to the criteria of a specific application. Sixteen criteria contribute to fully defininig the requirements of robust membrane element

sui quali la progettazione doveva tendere e assolvere. La tenuta assiale abbinata ad una connessione rotazionale, soddisfaceva in pieno i 16 requisiti pre-stabiliti, rendendo inadeguata l' applicazione con tenuta radiale. Prototipi di interconnessione rotazionale con o-ring assiali sono stati testati in laboratorio e sul campo e poi descritti compiutamente in queste pagine. La caratteristica fondamentale rilevata, è quella che iLEC™ offre un accoppiamento tra membrane superiore a quello fornito da un' interconnessione tramite adattatori radiali ad inserto. La primaria importanza che riveste la reiezione salina nelle membrane ad osmosi inversa di nuova generazione, poneva il problema che tutti i componenti utilizzati per la sua produzione dovevano essere adeguati al compito. Una tenuta assiale con interconnessione rotazionale era la risposta giusta al problema.

REFERENZE

1. Parker O-ring Handbook. Catalog ORD 5700A/US. Parker Hannifin Corporation, Cleveland, Ohio, USA; 2001.
2. Westaway, C.R., Loomis, A.W., eds. Cameron Hydraulic Data. Ingersoll-Rand Company, Woodcliff Lake, New Jersey,USA; 1981.

coupling. An axially-compressed seal with rotational connection fully meets these criteria while the traditional sliding radial seal is in adequate or marginal in many functional aspects. A working prototype embodiment of an axial seal with rotational mechanical connection has been described along with broad field trial and laboratory results. The fundamental aspects of this seal configuration result in a superior sealing technology over a sliding radial seal for the given application of coupling membrane elements. Realizing the full potential of high rejection membranes in advanced reverse osmosis systems requires all components to be appropriate for the task. An axial seal with rotational mechanical connection is the correct answer for coupling membrane elements.

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1. Parker O-ring Handbook. Catalog ORD 5700A/US. Parker Hannifin Corporation, Cleveland, Ohio, USA; 2001.
2. Westaway, C.R., Loomis, A.W., eds. Cameron Hydraulic Data. Ingersoll-Rand Company, Woodcliff Lake, New Jersey,USA; 1981.

CARATTERISTICHE DELL' ACQUA IN ALIMENTO ALLE MEMBRANE/CHARACTERISTICS IN FEED WATER MEMBRANES

Acqua in alimento

La conoscenza delle caratteristiche chimiche dell' acqua in alimento alle membrane è una condizione indispensabile per decidere il tipo di pre-trattamento più idoneo e per progettare al memglio l' impianto RO/NF. Un pre-trattamento inefficiente può comportare precipitazione inorganica, sporcamenti organici e biologici con conseguente degradazione della membrana. Ci sono quattro tipologie di acqua in alimento:

• L' acqua di pozzo è generalmente assente da sostanze colloidali e in sospensione con un basso potenziale di sporcamento. In queste acque spesso è sufficiente l' utilizzo di un' inibitore contro la precipitazione inorganica e un filtro da 5 øm.

• L' acqua di superficie è caratterizzata da variazioni stagionali, con alti livelli di solidi sospesi e alta attività microbiologica che causano inevitabili sporcamenti. Il pre-trattamento consiste nell' utilizzo di flocculanti, addizione di polimeri, chiarificazione e filtri multistrato.

• Le acque di processi industriali e quelle municipapali sono costituite da una grande varietà di composti organici ed inorganici. In questo caso lo studio di un pre-trattamento idoneo è prioritario

• Acqua di mare. A causa dei valori alti di TDS (~ 35,000 mg/L), la precipitazione inorganica non è un grande problema come nell' acqua salmastra, poichè le percentuali di recupero dell' acqua marina vanno da un 30 a un 45%. Recuperi superiori al 35%, necessitano di un inibitore (antiscalante) come pre-trattamento.

Problemi specifici:

Di seguito si illustrano i problemi specifici causati da un' acqua di mare o da pre-trattamenti non idonei o da condizioni operative non ottimizzate che possono causare anomalie sugli impianti RO/NF anche di carattere grave ed irreversibile:

• Sostanze inslubili e materiale colloidale come il limo, la silice e Fe_2O_3 intasano le membrane. Queste sostanze possono essere misurate con l' SDI. Se l' SDI è > 3.0, si rende necessario un pre-trattamento con flitri multistrato o filtri a cartuccia.

• I sali solubili quali solfato di calcio, di bario, di stronzio, silice, carbonato di calcio, fluoruro e fostato, possono tutti precipitare sulla membrana soprattutto quando i recuperi sono troppo elevati. Il carbonato di calcio è quello che precipita più comunemente. L' indice di Langelier (LSI) sul concentrato, può essere positivo se si utilizza un antiscalante per il controllo del $CaCO_3$.

• Silice: la sua solubilità dipende da pH, temperatura, alcalinità totale e concentrazione di SiO_2. Quando la silice raggiunge la sovra saturazione, può formare silice colloidale. La sua solubilità diminuisce in presenza di Al e Fe.

• I metalli quali ferro, alluminio e manganese, possono essere di origine naturale o provenienti da ruggine. Essi possono dar luogo ad ossidi insolubili. Il loro limite nell' acqua deve essere < 0.05 mg/L

• Potenziale sporcamento biologico: è presente in genere nelle acque di superficie dove esistono alti livelli di sostanze nutrienti (carbone organico e assimilati, fosfati, nitrati). I microrganismi proliferano aderendo sulla superficie della membrana formando un biofilm. Lo sporcamento è causato da cattiva conservazione della membrana, non corretta gestione del filtro a carbone o da dosaggio insufficiente di biocida.

• Le sostanze organiche naturali derivano dalla presenza di sostanze umiche generalmente in concentrazioni di 0.5 - 20 mg/L TOC. Quando il TOC è > 3 mg/L i pre-trattamenti utilizzati sono: ultrafiltrazione, carboni attivi o coagulazione.

• Ossidanti quali cloro, ozono, permanganato di potassio, ipoclorito di sodio o calcio, causano danni irreversibili alla

Feed Water

The water chemistry of the raw feed is critical to understand in order to determining the degree and type of pre-treatment to ensure efficient operation of reverse osmosis and nanofiltration (RO/NF) systems. Ineffective pre-treatment of membrane systems can lead to scaling, biological or organic fouling and membrane degradation. There are four main sources of raw water for RO/NF systems:

• Well water is generally free of suspended and colloidal impurities with low fouling potential. It typically requires a very simple pre-treatment such as scaling inhibitor addition and a 5 øm cartridge filter.

• Surface water has seasonal variation, high levels of suspended solids and microbiological activity with a high fouling potential. Pre-treatment often includes flocculation, polymer addition, clarification, and multimedia filtration.

• Industrial and municipal wastewaters have a wide variety of organic and inorganic constituents, so a well-designed pre-treatment scheme is imperative.

• Seawater. Due to the high TDS of the feed (~ 35,000 mg/L), scaling is not as much of a problem as in brackish water plants because the recovery of sea water plants is limited by the osmotic pressure of the concentrate stream to 30fi45%. Above 35% recoveries, a scale inhibitor is recommended as pre-treatment.

Problem species:

The following are common species present in the feed water or pre-treatment that can cause problems with the RO/NF membranes if pre-treatment or operating conditions are not optimized:

• Insoluble species and colloidal materials such as silt, silica or Fe_2O_3 block the membranes. Can be measured by Silt Density Index (SDI). If SDI > 3.0, pre-treatment with media filter and/or cartridge filter should be considered.

• Sparingly soluble salts (sulfates of calcium, barium, strontium, silica, calcium carbonate, fluoride and phosphates) can all produce scaling of the membrane, particularly if the recovery is too high. Calcium carbonate is the most common precipitate. Langelier Saturation Index (LSI) in the brine stream can be positive if antiscalant is used to control $CaCO_3$ scale.

• Silica: solubility depends on pH, temperature, total alkalinity and SiO_2 concentration.

When supersaturated, can form insoluble colloidal silica. Solubility decreases in the presence of Al or Fe.

• Metals (iron, aluminum, manganese) may be natural or from equipment (e.g. rust).

They can form insoluble oxides or hydroxides. The limit should be < 0.05 mg/L in the feed water.

• Biofouling potential: common in surface waters where high nutrient levels are present (assimilable organic carbon, phosphates, nitrates).

Microorganisms grow and adhere to the membrane surface and form a biofilm. Fouling is caused by improper membrane preservation, carbon bed maintenance or insufficient biocide dosage.

• Natural organic matter are humic substances typically in concentrations of 0.5 - 20 mg/L TOC.

Pre-treat with ultrafiltration, activated carbon or coagulation when TOC > 3 mg/L.

• Oxidants (chlorine, ozone, potassium permanganate, sodium or calcium hypochlorite) cause irreversible membrane damage.

membrana. Rimuovere gli ossidanti con metabisolfito. Variazioni importanti nella composizione e nella temperatura dell' acqua, possono causare problematiche importanti sul corretto funzionamento dell' impianto. La tabella sotto illustra gli effetti prodotti sulle membrane:

Remove oxidants by dosing sodium metabisulfite. Significant changes in water composition/temperature can have a serious impact if plant operating conditions are not adjusted accordingly. The following table summarizes the effect on the membranes:

- Variazione dell' acqua - Change in Feed Water	- Effetti dei problemi sulle membrane - Effect of problem on membranes	- Flusso permeato - Permeate Flow	- Concentrazione salina nel permeato - Permeate Salt Concentration	- Perdita di carico - Pressure Drop	- Azioni correttive - Corrective Measures
Incremento TDS Increased TDS	Incremento pressione osmotica Increased osmotic pressure	↓	↑	0	Correggere condizioni operative Correct operating conditions
Incremento durezza totale Increased total hardness	Precipitazione Scaling	↓↓	↑	↑	Lavaggio Clean
Incremento di colloidi Increased colloids	Colloidi/sporcoto da silice Colloidal / silica fouling	↓↓	↑	↑	Lavaggio Clean
Metalli nell' acqua (o corrosione) Metals in feed (or corrosion)	Sporcamento metalli ossidati Metal oxide fouling	↓↓	0	↑	Lavaggio Clean
Incremento organici naturali Increased natural organics	Sporcamento organico Organic fouling	↓↓	0	↑	Lavaggio Clean
Incremento potenziale biofouling Increased biofouling potential	Sporcamento biologico Biofouling	↓	0	↑↑	Lavaggio Clean
Presenza di H_2S H_2S present	Sporcamento da zolfo Sulfur fouling	↓	0	↑	Sostituire elementi Replace elements
Alta temperatura Excessive temperature	Compattazione membrana Membrane compaction	↓↓	↓	0	Sostituire elementi Replace elements

La tabella sopra mostra che i problemi nell' acqua di alimento sono:
• la variazione della composizione dell' acqua porta a sporcamenti organici ed inorganici che riducono il flusso di permeato fino all' intasamento della membrana. Generalmente il passaggio salino aumenta.
• Una temperatura eccessiva danneggia meccanicamente la membrana e riduce il passaggio salino.
• L' incremento delle perdite di carico deve essere risolto immediatamente causa un' incremento sempre maggiore.
Analisi dell' acqua in alimento: a causa delle problematiche sopra esposte, una completa ed accurata analisi si rende necessaria prima di progettare un impianto RO/NF. L' analisi dovrebbe essere dettagliata e la concentrazione degli anioni e cationi totali bilanciata. Se l' analisi non è bilanciata, aggiungere Na^+ o Cl^{fl} per raggiungere la elettro-neutralità. Ba^{2+} e Sr^{2+} devono essere rilevati rispettivamente al øg/L (ppb) e al mg/L (ppm). E' anche importante progettare l' impianto a vari range di temperatura piuttosto che stabilire una temperatura di progetto assoluta, in quanto le sue variazioni comportano distinti livelli di precipitazione inorganica, specialmente quando i livelli di silice nell' acqua sono alti. Sono disponibili diversi metodi analitici per il calcolo. Dopo l' aviamento della membrana, l' impianto dovrebbe essere normalizzato e monitorato costantemente (soprattutto per le acque di superficie e municipali), così da poter intervenire sul pre-trattamento aggiustando le anomalie ed evitando danni irreversibili.

The table shows that problems with feed water result in:
• Changing water composition leads to inorganic and organic fouling, which reduces permeate flow due to membrane blockage. Salt passage generally increases.
• Excess temperature mechanically damages the membrane and reduces salt passage.
• Pressure drop increases and will become worse if the problem is not resolved quickly.
Feed Water Analysis: due to the potential problem species described above, a complete and accurate water analysis is needed before a projection of an RO or NF system design can be run. A water analysis form should be completed and the anion and cation concentrations balanced to electroneutrality. If the water analysis is not in balance, add either Na^+ or Cl^{fl} to achieve electroneutrality. Ba^{2+} and Sr^{2+} must be analyzed at the 1 øg/L (ppb) and 1 mg/L (ppm) level of detection, respectively. It is also important that the temperature be given as a range rather than an absolute temperature, as temperature variation can impact the scaling potential of an RO system, especially when silica levels in the feed water are high. Recommended analytical methods are available. After the membrane is in service, the plant performance should be normalized to monitor any changes and the feed water analyzed on a regular basis (especially surface and municipal sources), so that the pre-treatement and the plant operation can be adjusted accordingly.

RISOLUZONE DEI PROBLEMI:"CONTROPRESSIONE", ABRASIONE E ALTRI DANNEGGIAMENTI/: TROUBLESHOOTING "BACKPRESSURE, SURFACE ABRASION AND OTHER DAMAGE"

Contropressione, abrasioni e altri danneggiamenti
Oltre alle problematiche dovute ai danneggiamento da telescopicizzazione, le membrane possono subire altri danneggiamenti di tipo meccanico: contropressione sul permeato, abrasione e compattazione dei fogli semipermeabili (compattazione della membrana). La compattazione è un fenomeno causato dalla compressione dello strato di polisulfonee contemporanea intrusione della membrana semipermeabile all' interno degli spaziatori. Tali danneggiamenti si possono ripercuotere anche su tubazioni, riduttori, interconnettori e o-rings.

Cause: da ricercare soprattutto da incorrette installazioni o errato funzionamento dei moduli RO/NF:

• Contropressione: se la contropressione statica sul tubo del permeato è > 0.3 bar (5 PSI) rispetto al concentrato, la membrana può lacerarsi e danneggiarsi irreversibilmente.

• Abrasione della superficie: particelle affilate o cristalline presenti nell' acqua di alimento o non filtrate perfettamente, causano abrasioni della superficie filtrante delle membrane presenti nel primo stadio.

• Compattazione: una pressione troppo elevata, una temperatura eccessiva o colpi di ariete, provocano una compattazione della membrana con rottura del tubo permeato

Identificazione:

• I danneggiamenti di tipo meccanico sono visibili nelle foto sotto. Il laceramento della membrana si presenta soprattutto tra la striscia di colla in alimento, la striscia di colla più esterna e la striscia di colla sul lato concentrato. L' abrasione si evince con un esame tramite microscopio effettuato sulla superficie filtrante della membrana.

• Eventuali rotture delle membrane possono essere rilevate tramite sonde o test di fuga.

Backpressure, surface abrasion and other damage
In addition to membrane telescoping, other main types of membrane mechanical damage are tearing (permeate backpressure damage), surface abrasion and compression of the membrane leaves (membrane compaction). Compaction is a combined effect of compression of the polysulfone layer and an intrusion of the membrane into the permeate spacer.
Note that mechanical damage can also occur to other components such as water tubes, adaptors, interconnectors and O-rings.

Causes: mostly originates from incorrect installation or operation of the RO/NF elements:

• Backpressure: if permeate pressure > 0.3 bar (5 PSI) above the concentrate pressure at any time, tearing of the membrane can occur.

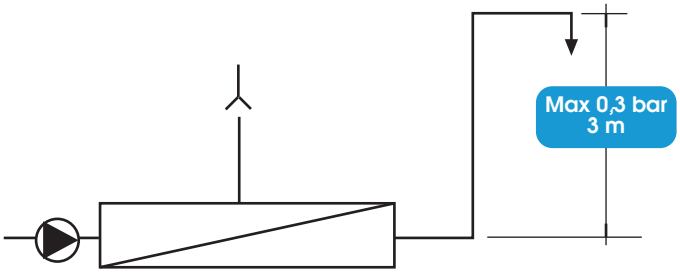
• Surface abrasion: crystalline or other sharp-edged particles in the feed water entering the element e.g. through by-passing of the pre-filtration cause surface abrasion in the first stage elements.

• Compaction: too high feed pressure, high temperature or a water hammer cause membrane compaction and cracked product water tube.

Identification:

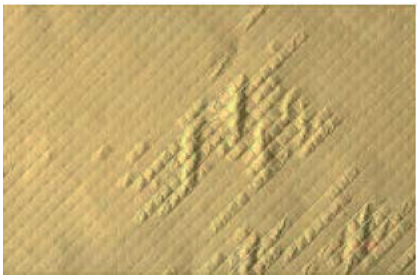
• Mechanical damage to the elements is visible - see photographs below. Tearing of the membrane occurs mostly in the edges between the feed-sided glue line, the outer glue line and the concentrate-sided glue line. Surface abrasion is evident from microscopic examination of the membrane surface.

• Torn membranes can be identified by probing and confirmed by a leak test.

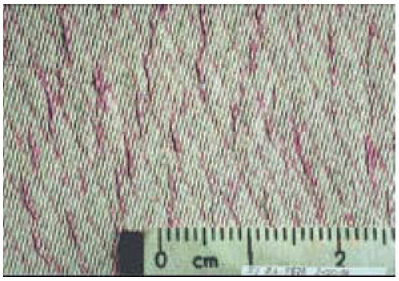


- Le membrane sono sensibili ai flussi contrari alla direzione del permeato. Questo fenomeno può accadere quando viene predisposto un serbatoio per la raccolta di acqua osmotizzata ad un' altezza superiore ai 3 metri. Al blocco della pompa di alimentazione il peso della colonna d' acqua rigonfia i fogli delle membrane con un effetto palloncino provocando danni irreversibili.
- Membrane elements are sensitive to flow of water in the wrong direction i.e. from the permeate to the feed side. This can typically happen when water is pumped to a permeate storage tank above the plant level. If the feed pump stops e.g. a power outage, then a water column pressure >0.3 bar on the permeate inflates the membrane envelopes like a balloon, causing irreversible damage.

- Questa fotografia mostra le rughe e le impronte lasciate dagli spaziatori sopra la superficie filtrante della membrana causati dalla contro-pressione idraulica.
- This photograph shows the wrinkles and also the impressions of the feed channel spacer onto the membrane surface caused by back pressure.



- Ripetute contro-pressioni esercitate sulla membrana, possono provocare delaminazioni e rigonfiamenti come mostrato in questa foto. La membrana delaminata viene spinta verso gli spaziatori. Quando accade questo fenomeno, il supporto in poliestere si stacca dallo strato superiore di polisulfone.
- With repeated back pressure exerted onto the membrane, de-lamination or blistering can also occur as shown on this photo. The membrane has delaminated and tried to push through the structure of the feed channel spacer. When de-lamination occurs, the polyester support web detaches from the polysulfone polyamide top layers.



- Questa fotografia mostra il danneggiamento della membrana da compattazione, ovvero la membrana si deforma tanto da incunearsi dentro gli spaziatori (ben visibile nella foto). In questo caso l' intrusione della membrana è stata così violenta portando alla rottura della stessa, come si evince dalla colorazione del polisulfone tramite una prova colorimetrica.
- This photograph shows compaction damage with membrane deformation and intrusion into the permeate spacer. The impression of the spacer structure underneath can be seen. The intrusion was so excessive in this case that the membrane cracked, as evidenced by the coloration of the polysulfone layer in this dye test.

Problemi e sintomi:
• Le rotture delle membrane provocano sia un aumento di soluto rispetto alle condizioni normalizzate che una perdita di pressione.
• Le abrasioni della superficie filtrante causano un aumento di soluto rispetto alle condizioni normalizzate.
• La compattazione della membrana causa sia una riduzione della portata del permeato che della reiezione salina normalizzata
•Lo scollamento della membrana o la rottura del tubo permeato, provocano sia un aumento della salinità che l' aumentom del flusso del permeato
Azioni correttive: **sostituzione degli elementi danneggiati e risoluzione delle cause di danneggiamento**:
• Le membrane danneggiate devono essere sostituite e le cause di eccessive contropressioni eliminate.
• Quando la superficie della membrana è danneggiata, dovrebbe essere sostituita e il pre-filtro a carbone opportunamente flussato
• Controllare tubi di alimentazione, adattatori, interconnettori e o-rings e procedere alla loro sostituzione se danneggiati.
• Verificare le tenute dell' impianto e del valvolame.
Prevenzione: **esistono molti modi per verificare il danno subito della membrana osmotica**:
• Per le membrane lacerate, eliminare ogni causa di eccessive contropressioni.
• Per superfici abrase, pulire e flussare la linea di alimentazione prima dello start-up e procedere all' installazione di un filtro.
• Nel caso la contropressione sul tubo del permeato è > 0.3 bar, procedere all' installazione di una valvola di non ritorno sul permeato per limitare gli effetti del fermo impianto.

Symptoms of Trouble:
• Torn membranes cause increases in the normalized solute passage and pressure drop.
• Surface abrasion leads to increased normalized solute passage.
• Membrane compaction causes a reduction in normalized solute passage and permeate flow.
• Glue line leaks or cracked product water tube result in increased normalized solute passage and permeate flow.
Corrective actions: **Replace the damaged element(s) and correct the causes**:
• Torn membranes need to be replaced and the excessive backpressure relieved.
• Surface damaged membranes should be replaced and the carbon filter properly flushed.
• Check other components such as water tubes, adaptors, interconnectors and O-rings and replace if damaged.
• Check isolating and check-valves for leaks.
Prevention: **there are several ways to control membrane damage**:
• For torn membrane damage, eliminate source of high permeate backpressure.
• For surface abrasion, clean and flush line before start-up and install cartridge filter.
• In the case of permeate backpressure > 0.3 bar, install a check valve in the permeate line to limit permeate back-flow on shut-down.

RISOLUZONE DEI PROBLEMI:"DANNEGGIAMENTO CHIMICO"/: TROUBLESHOOTING "CHEMICAL DAMAGE"

Danneggiamento chimico della membrana

Accade quando la superficie della membrana è attaccata fino a degradarsi da agenti chimici aggressivi. Questo può accadere durante i lavaggi chimici periodici. E' da sottolineare il fatto che eventuali danni chimici, possono ripercuotersi anche su tubazioni, riduttori, interconnettori e o-rings.

Cause: le cause trovano origine generalmente in una gestione incorretta delle membrane RO/NF, portando la membrana al contatto con agenti ossidanti quali cloro libero, bromo, ozono o altri agenti chimici incompatibili. Gli attacchi alla membrana vengono favoriti a pH neutri o alcalini. La membrana è stabile contro la maggior parte degli agenti chimici in un range di pH compreso tra 2 e 11 finché questi rimangono disciolti e non si trasformano in prodotti organici.

Identificazione:

•Eseguire un test colorimetrico della membrana, seguito da un' autopsia. Le aree chimicamente danneggiate lasciano un' impronta colorata. Gli elementi più colpiti sono generalmente i primi dell' impianto.

• Il test ESCA e i Raggi X fluoresenti sono capaci di scoprire gli alogeni, indice di danno da agenti ossidanti - vedi spetrometro sotto.

• Il danneggiamento da ossidazione può avvenire anche con l' utilizzo di disinfettanti ossidanti quando i valori di temperatura e pH non vengono osservati. In questo caso è probabile che si verifichi un danno uniforme.

• Una membrana FILMTEC danneggiata da agenti ossidanti rimane meccanicamente intatta al test di vuoto.

Membrane chemical damage

Occurs when the membrane surface is attacked and degraded by aggressive chemicals. This may occur during the normal operation or through cleaning. Note that chemical damage can also occur to other components such as water tubes, adaptors, interconnectors and O-rings.

Causes: mostly originates from incorrect operation of the RO/NF elements, allowing exposure to oxidative agents such as free chlorine, bromine, ozone or other incompatable chemicals. A neutral to alkaline pH favors the attack to the membrane. As a rule of thumb, all oxidizing agents can harm the membrane and must be removed. The membrane element is stable against most other chemicals in a pH range of 2fi11 as long as these chemicals are dissolved and not occurring as an organic phase.

Identification:

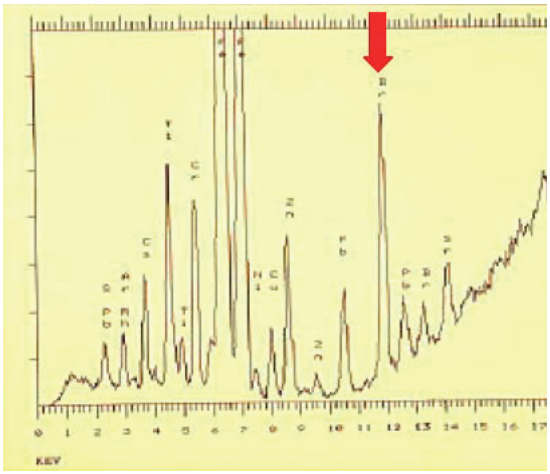
• Conduct a membrane dye test followed by autopsy. Chemically damaged areas of the membrane take up the dye less readily. The front end elements are typically more affected than the others.

• ESCA and X-ray fluorescence are able to detect halogens, which are indications of oxidative damage - see spectra below.

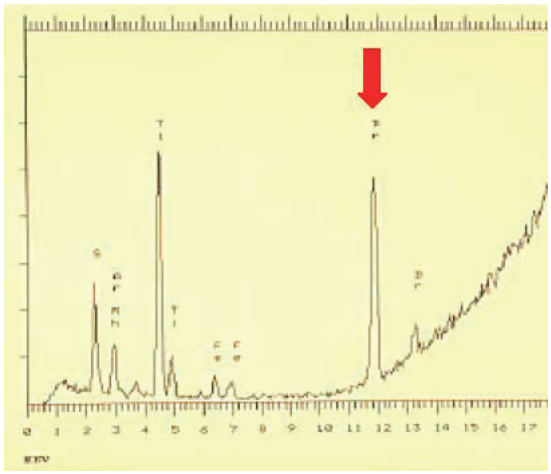
• Oxidation damage may also occur by disinfecting with oxidizing agents, when pH and temperature limits are not observed.

In this case, a uniform damage is likely.

• A FILMTEC element with oxidation damaged membrane is still mechanically intact when subjected to the vacuum test.



- La prova a raggi x eseguita su un campione di membrana mostra la presenza di bromo sullaparte destra dello scanner. Il fenomeno è dovuto con tutta probabilità alla presenza di bromuri depositatisi sulla membrana. Questo è comunque un sintomo che la membrana ha subito un danno da agenti ossidanti.
- This high energy x-ray fluorescence spectrum of a membrane sample received demonstrates the presence of bromine at the center right hand side of the scan. This may be due to bromides that have deposited on the membrane, but more frequently it is an indication of membrane oxidative damage.



- La stessa scansione è stata eseguita dopo un lavaggio chimico e, nonostante ciò, si evince ugualmente la presenza di bromo. Il fenomeno viene generalmente evidenziato in quegli impianti dove è stato eseguito un pre-trattamento con cloro. Il cloro infatti trasforma il bromuro in bromo libero che successivamente ossida lo strato di poliammide della membrana causando un' alto passaggio salino e danni irreversibili.
- The same scan after cleaning shows that the bromine peak is still present, indicating it has reacted with the membrane. Bromine damage typically occurs with chlorinated feed waters containing bromide. Chlorine converts the bromide to free bromine, which then oxidizes the polyamide membrane structure, causing irreversible membrane damage and an increase in salt passage.

Problemi e sintomi:
• Un passaggio salino elevato in combinazione con un flusso alto di permeato, è causa di danno dovuto ad ossidazione.
Azioni correttive:
Non sono possibili azioni correttive. Tutti gli elementi danneggiati devono necessariamente essere sostituiti
Prevenzione
Esistono diversi accorgimenti per evitare i danni alla membrana:
• Sia gli agenti ossidanti che i prodotti chimici dannosi devono essere rimossi prima di entrare nelle membrane. E' possibile dosare un agente riducente quale il bisolfito di sodio (SBS), per 1 mg/L di cloro libero rimosso vengono dosati 3 mg/L di SBS.
• Può essere utilizzato anche il carbone attivo, tuttavia questo può causare (se non opportunamente flussato) sia danni abrasivi che un rischio potenziale di formazione batterica e conseguente bio-fouling. Se i passi sopra citati non risolvono il problema, la membrana potrebbe essere danneggiata da altri fattori; in questo caso si può utilizzare il sito Filmtec www.filmtec.com o contattare l' Ufficio tecnico Hytek per la risoluzione del problema.

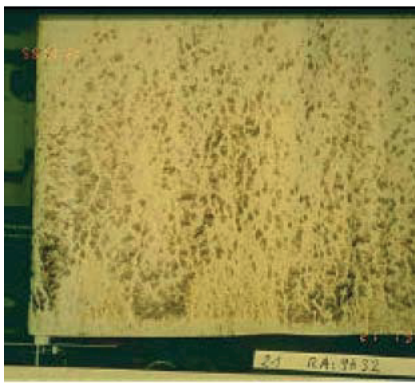
Symptoms of Trouble:
• A high salt passage in combination with a higher than normal permeate flow is mostly due to oxidation damage.
Corrective actions:
No corrective action is possible. All damaged elements must be replaced.
Prevention:
there are several ways to control membrane damage:
• Oxidizing chemicals must be removed upstream of the membranes. This can be done by dosing a reducing agent (commonly sodium bisulfite, SBS). 1 mg/L free chlorine requires 3 mg/L SBS to remove it.
• Activated carbon can also be used, but note potential for carbon fines leading to membrane surface abrasion and risk of accumulation of microorganisms that could cause biofouling.
If the above steps do not solve the problem, the system could have a membrane related problem. Use the symptom / cause / solution matrixes on the Liquid Separations web site at www.filmtec.com to troubleshoot further.

RISOLUZONE DEI PROBLEMI:"SPORCAMENTO BIOLOGICO"/: TROUBLESHOOTING "BIOFOULING"

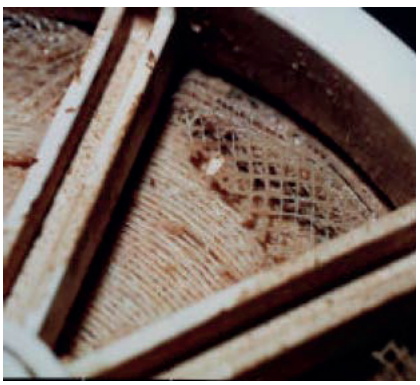
Sporcamento biologico
I microrganismi quali batteri, alghe, funghi, virus e altri, sono presenti in acque non pre-trattate. Anche se il loro comportamento è simile a quello dei colloidi (i batteri sono ~1fi3 øm), loro formano, in condizioni favorevoli, un biofilms sulla superficie delle membrane di difficile rimozione. Una rimozione incompleta porta all' inevitabile riformazione del biofilms, rendendo il pre-trattamento un processo critico e importante
Cause: sono generalmente da ricercare in un' acqua biologicamente attiva e in un pre-trattamento improprio. Il potenziale biologico è più elevato in acque di superficie che in quelle di pozzo. Una soluzione conservante di bisolfito troppo vecchia, troppo calda o troppo ossidante, può inquinare la membrana.
Identificazione:
Lo sporcamento biologico si evince con la variazione dei parametri di funzionamento dell' impianto (generalmente sulle prime membrane) come di seguito illustrato:
• Il biofilm è spesso identificato come un rivestimento limaccioso sul lato di alimentazione degli elementi RO. Di solito il biofilm si intravede anche nei tubi di alimentazione e sui raggi che bloccano la membrana - vedi fotografia sotto.
• I biofilms sono scivolosi al tatto e spesso emanano un cattivo odore a causa delle degradazioni delle loro proteine.
• L' entità dello sporcamento biologico può essere determinato pesando la membrana.
• Un alta concentrazione batterica si può misurare in alimento, sul concentrato o sul permeato.
• Lo sporcamento biologico può causare danni meccanici alla membrana quali telescopicizzazione e danneggiamento della vetroresina per eccessiva perdita di carico.

Biofouling
Micro-organisms (bacteria, algae, fungi, viruses, higher organisms) are present in raw waters. Although similar to colloids (bacteria are ~1fi3 øm), they form biofilms on membranes under favorable conditions, which are difficult to remove. Incompletely removed biofilms also lead to rapid re-growth.
Biofouling prevention is therefore critical in the pre-treatment process.
Causes: mostly a combination of a biologically active feedwater and improper pre-treatment. Biofouling potential is higher in surface water than well water.
Elements or RO systems preserved in a bisulfite solution can also become biofouled if the preservation solution is too old, too warm or oxidized.
Identification:
Biofouling of the membranes is indicated by the following changes in the operating parameters, predominantly in the first stage of the system:
• Biofilm is often visible as a slimy coating on the feed side of the RO element. Usually the feed water pipes and the spokes of the anti-telescoping device are also coated - see photographs below.
• Biofilms feel slippery to the touch and often have a bad smell, due to denaturation of the biofilm proteins.
• The extent of biofouling can be determined by weighing the lead element.
• High counts of microorganisms in water samples taken from the feed, concentrate or permeate.
• Biofouling can also cause mechanical damage to the membrane element such as telescoping and fiberglass damage from excessive pressure drop.

- L' autopsia mostra in questo caso, che il biofilm limaccioso non solo ha coperto il lato di alimentazione della membrana ma è proliferato anche negli spaziatori di alimentazione attraversando la superficie della membrana.
- An autopsy shows in this case, that the slimy biofilm has covered not only the feed side of the membrane but has grown into the feed channel spacers and across the membrane surface.

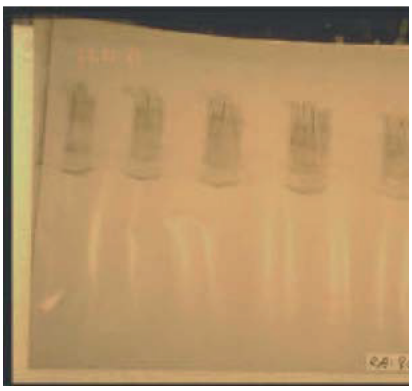


- Il biofilm si riscontra in aspetto e colorazioni differenti. In questo caso il colori che si sono evidenziati erano il grigio e il nero, distribuiti su tutti i fogli della superficie filtrante della membrana. La parte sinistra della fotografia mostra il tubo permeato.
- Biofilm comes in various colours and appearances, in this case it was gray and black and covered all of the membrane envelopes. The left hand side of the photo shows the permeate water tube.

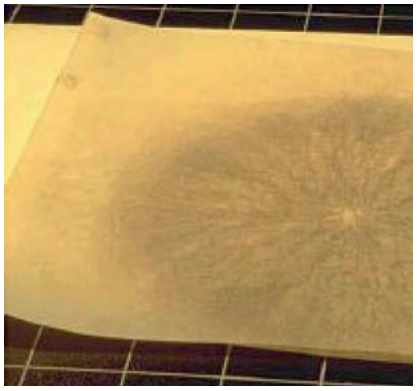


- Il biofilm diminuisce il flusso di acqua attraverso la membrane, aumentando talmente la perdita di carico al punto di spingere gli spaziatori di alimentazione fuori dal modulo RO.
- A biofilm restricts water flow through the element and the pressure drop becomes so high that the feed channel spacers may be pushed out of the RO module.

- In questo caso, il biofouling ha ricoperto la superficie della membrana e lo spaziatore. La sezione di un campione, permette di quantificare il livello di contaminazione espresso in grammi di biofilm per superficie filtrante, così da poter stimare la procedura più ottimale per il lavaggio chimico.
- In this case, the biofouling has covered the spacer and the membrane surface. A sample allows quantification of the contamination level in gram biofilm per membrane area and an estimate of how much cleaning chemical will be needed to remove the biofilm.



- Ecco una membrana che non è stata opportunamente flussata dopo una sosta prolungata. Al momento del fermo macchina, il vessel è stato parzialmente riempito agevolando la proliferazione batterica (funghi) dei microrganismi presenti in soluzione. Tale fenomeno è rilevabile su tutta la superficie filtrante della membrana .
- Here is a membrane that was not properly flushed out before a long operational standstill. The pressure vessel was partially filled with liquid, which allowed fungus to grow on parts of the membrane that were immersed in the contaminated solution.



- Questa fotografia mostra un esempio di crescita di fungo sulla membrana. In questo caso si può notare al centro, il punto iniziale di proliferazione causato dalla spora che, successivamente, si è espansa in maniera esponenziale.
- This photo shows an example of a fungus that grew in a membrane. In this case a pinhole at the centre of this fungal growth was the starting point from where the fungal spore had grown to such enormous size.

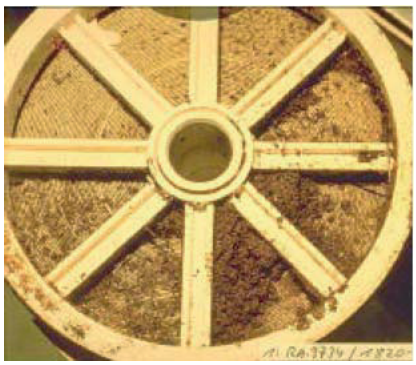
Problemi e sintomi:
I problemi generati dallo sporcamento biologico sono generalmente quelli esposti sotto:
• Calo del flusso di permeato a pressione e recupero costante. Negli stadi avanzati di sporcamento (formazione di bio-masse), il recupero diminuisce.
• Diminuzione del flusso permeato rispetto alle condizioni normalizzate; questo normalmente si riscontra con un aumento della pressione di alimento per mantenere costante la produzione del permeato. L' aumento di pressione protratto per lungo tempo, causa l' aggravio del problema di biofouling rendendo più difficoltoso il lavaggio chimico per il ripristino delle condizioni normalizzate dell' impianto.
• Brusco aumento delle perdite di carico quando l' inquinamento batterico è massiccio o combinato insieme a limo. La perdita di carico attraverso le membrane è un tipico indicatore di fouling, per cui è fortemente raccomandato l' utilizzo di indicatori di pressione in ogni stadio del sistema RO/NF.
• Il pasaggio salino inizialmente rimane basso e contenuto, tuttavia aumenta all' aumentare dell' inquinamento.
Rimozione: per i dettagli relativi alleprocedure di lavaggio, vedi capitolo dei prodotti chimici Hytek (HY-CARE).
• Pulire e sanitizzzare interamente l' impianto, incluso il pre-trattamento e le membrane. Una pulizia inadeguata o incompleta, darà luogo nuovamente ad una rapida contaminazione.
Prevenzione:
ci sono molti modi per controllare lo sporcamento biologico:
• Per lo stoccaggio, rinnovare la soluzione di conservazione delle membrane e stoccare in ambiente fresco, asciutto e poco luminoso.
• Analizzare l' acqua e determinare potenziali rischi di biofouling.
• Installare ed ottimizzare il pre-trattamento: eseguire un dosaggio shock durante l' esercizio per un breve tempo (bisolfito di sodio o ANTIMICROBIAL). In un' acqua biologicamente attiva, il biofilm può formarsi dopo 3fi5 giorni (in estate) e circa ogni 7 giorni in inverno. Occorre quindi dosare in tale frequenza il biocida. I dosaggi durano circa 30 minuti e sono tipicamente di 0.5fi1,0 g/L per il bisolfito di sodio o di 10-40 mg/l per ANTIMICROBIAL.
• Prevedere come pre-filtrazione un filtro a carboni attivi (GAC). Il GAC è progettato per trattenere batteri e la crescita microbiologica avviene sul letto dei carboni e non sulla membrana. Questo permette al modulo RO/NF di rimanere biologicamente stabile.
• La microfiltrazione/ultrafiltrazione può rimuovere i microrganismi, specialmente le alghe. Le membrane MF/UF, dovrebbero essere costituite da materiale cloro-resistente per permettere trattamenti periodici con biocidi.
• Clorinazioni shock possono essere utilizzate in alternativa ai biocidi, tuttavia queste devono riguardare esclusivamente il pre-trattamento e non le membrane. Si dosano tipicamente fino a 5 mg/L di cloro libero. Può essere usato in alternativa anche ozono.
• Installare membrane Filmtec (FR) più resistenti allo sporcamento.

Symptoms of Trouble:
Trouble with biofouling of a RO/NF system normally means at least one of the following:
• Permeate flow decreases when operated at constant feed pressure and recovery. Recovery decreases in cases where biofouling is advanced to large biomasses.
• Loss of normalized permeate flow rate; in practice this is normally seen as a feed pressure increase in order to maintain the permeate output.
Increasing feed pressure is self-defeating when carried out over a long time, since it increases the biofouling, thus making it more difficult to clean later.
• Differential pressure increases sharply when the bacterial fouling is massive or when it is combined with silt fouling. Since pressure drop across the pressure vessels is a sensitive indicator of fouling, it is strongly recommended to install pressure-monitoring devices on each array in a system.
• Solute passage remains normal or even low initially, but increases when fouling becomes massive.
Removal: For details of cleaning procedures, see chapter of the chemical products Hytek (HY-CARE).
• Clean and sanitize the entire system, including the pre-treatment section and the elements. An incomplete cleaning and disinfection will result in rapid re-contamination.
Prevention:
there are several ways to control biofouling:
• For stored membranes, renew aged preservation solution. Store in cool, dry, dark environment.
• Check feedwater analysis for biofouling potential.
• Install or optimize the pre-treatment: shock treatment by adding a biocide (sodium bisulfite or ANTIMICROBIAL) to the feed stream during normal plant operation for a limited time. In biologically active feed water, a biofilm can appear within 3fi5 days, so biocide-treat at the same frequency during peak biological activity (summer) and ~ 7 days in winter. Dosages are typically 0.5fi1,0 g/L for sodium bisulfite or 10-40 mg/l ANTIMICROBIAL for 30 mins.
• Install a granular activated carbon (GAC) filter upstream to act as a biofilter.
The GAC is designed to allow microbiological growth to occur, so that the downstream water feed to the RO/NF stage is biologically stable.
• Microfiltration/ultrafiltration can remove micro-organisms, especially algae. The MF/UF membranes should be made from a chlorine-resistant material to withstand periodic treatment with biocides.
• Shock chlorinate the pre-treatment section only (drain and flush to avoid membrane exposure) as an alternative to biocides. Free chlorine concentrations up to 5 mg/L. Ozone is an alternative stronger oxidizing agent.
• Installation of Fouling Resistant (FR) elements.

RISOLUZONE DEI PROBLEMI:"SPORCAMENTO DA COLLOIDI"/: TROUBLESHOOTING "COLLOIDAL FOULING"

Sporcamento colloidale
E' un inquinamento dove delle particelle solide insolubili si accumulano sulla membrana RO. Esso è uno degli inquinamenti più diffusi negli impianti RO/NF. Le particelle presenti nell' acqua di alimento, possono essere limo, colloidi, batteri, creta, silice colloidale e prodotti corrosi e non qualificati come i granelli di sabbia. Essi possono danneggiare le performance dell' impianto abbassando la produttività e, qualche volta, la reiezione salina.
Cause: La causa principale dell' inquinamento colloidale è un' inefficiente o cattiva pre-filtrazione. L' utilizzo di prodotti chimici quali il solfato di alluminio, il cloruro ferrico o polielettroliti cationici possono provocare formazioni colloidali se non opportunamente rimossi dal filtro chiarificatore. I polimeri cationici possono precipitare insieme ad antiscalanti caricati negativamente, portando all' intasamento della membrana.
Identificazione:
• Spesso un primo segnale di inquinamento colloidale è la perdita di carico attraverso le membrane.
• Generalmente l' inquinamento si verifica sulle prime membrane che fermano le sostanze solide. Il problema è facilmente risolvibile se sono stati installati dei flussimetri sul permeato di ciascuno stadio.
• L' inquinamento colloidale è facilmente visibile-vedi foto sotto. Ispezionare i depositi sulla superficie della membrana srotolata del primo stadio.
• La gravità dell' inquinamento colloidale si può determinare anche pesando la membrana.
• Controllare frequentemente l' SDI dell' acqua. Il problema può essere causato da variazioni del sistema di pre-trattamento.
• Analizzare i residui dell' SDI e l' accumulo della sporcizia sulle cartucce pre-filtranti.
• Determinare la tendenza dell' acqua in ingresso allo sporcamento tramite l' SDI o l' MFI. Questi sistemi di misura dovrebbero essere sempre eseguiti prima di dimensionare un impianto di pre-filtrazione e RO/NF. E' buona norma eseguire le misurazioni durante il funzionamento dell' impianto (vengono consigliate 3 misurazioni al giorno per acque di superficie). L' SDI è l' indice più comunemente utilizzato.

Colloidal fouling
Particle fouling is the accumulation of insoluble solids on the RO elements. It is the most often encountered fouling problem in RO/NF plants. The particles may be fine silt or colloids from RO feed waters, include bacteria, clay, colloidal silica and corrosion products or coarser, such as sand grains. It can seriously impair performance by lowering productivity and sometimes salt rejection.
Causes: The main cause of colloidal fouling is failure of the pre-filtration to effectively trap the solids. Pre-treatment chemicals used in a clarifier such as aluminum sulfate, ferric chloride or cationic polyelectrolytes can also cause colloidal fouling if not removed in the clarifier or through proper media filtration. In addition, cationic polymers may co-precipitate with negatively charged antiscalants and foul the membrane.
Identification:
• An early sign of colloidal fouling is often an increased pressure differential across the system.
• Colloidal fouling usually occurs in the first stage, where the lead elements trap the solids.
The problem is easier to localize when permeate flow meters are installed in each array.
• Colloidal fouling is often visible - see photographs below. Inspect and analyze deposits on feed scroll end of first stage lead elements.
• The extent of colloidal fouling can be determined by weighing the lead element.
• Review recorded feed water SDI„s. The problem is sometimes due to infrequent excursions or pre-treatment upsets.
• Analyze residue from SDI filter pads and accumulations on pre-filter cartridges.
• Determine the fouling tendency of the RO feed water by measuring the silt density index (SDI) or the modified fouling index (MFI). These measurements should be carried out prior to designing an RO/NF pre-treatment system and on a regular basis during RO/NF operation (3 times a day is recommended for surface waters). The SDI is the most commonly used fouling index.



- Le fotografie mostrano della terra e sabbia di un pozzo passata attraverso un pre-trattamento andando ad intasare l' ingresso delle membrane. Le impurità sono schiacciate tra il vessel e l' involucro esterno in vetroresina della membrana. Si nota nella foto di destra, l' inquinamento che raggiunge la tenuta dove i fogli sono attaccati insieme spaccando la vetroresina. È praticamente impossibile pulire tale contaminazione.
-The photographs show soil and sand from a well that passed through the pre-treatment and blocked the feed side of the membranes. It squeezed between the pressure vessel and the outer membrane shell and the right photo shows it was also inside the element between the epoxy resin and the tape holding the membrane envelopes together. It is virtually impossible to clean such a contamination from the element.

- Le particelle inquinanti mostrate su questa membrana, sono talmente fini da essere passate attraverso il pre-filtro da 5 o 10 µm procurando la contaminazione.
- The particle fouling shown on this membrane element is a very finely dispersed suspended material that may have passed through a 5 or 10 µm pre-filter and caused contamination.

- La fotografia di sinistra mostra un elemento inquinato da fibre nere. La fotografia di destra mostra lo stesso elemento srotolato dove si evince la contaminazione avvenuta in ingresso ed in prossimità del tubo permeato. Questo avviene perchè in questa zona i flussi sono più alti ed inevitabilemnte la concentrazione dello sporco tende a concentrarsi.
- The left photograph shows an element contaminated with black fibers. The right photograph shows the unrolled element membrane envelopes with most contamination close to the permeate water tube at the feed side of the element on the right hand side of the photograph. This is because the flow rates are highest in this region and carry the particles through.

- Questa autopsia mostra la contaminazione che penetra in profondità su tutta la membrana.
- This autopsy shows deeply penetrated particle contamination throughout the membrane element.

Problemi e sintomi:
L' inquinamento colloidale può essere rilevato su un impianto RO/NF con l' identificazione di uno dei seguenti problemi:
• Basso flusso di permeato in riferimento alle condizioni normalizzate: generalmente per mantenere costante la produzione occorre aumentare la pressione in alimento.
• Incremento del passaggio salino rispetto alle condizioni normalizzate: aumento della conducibilità sul permeato.
• Incremento delle perdite di carico: a flusso costante la differenza tra la pressione in ingresso e quella sul concentrato diventa sempre più grande.

Rimozione:
• La pulizia degli elementi dipende dal tipo di sporcamento (può trovare i dettagli sui lavaggi chimici contro lo sporcamento colloidale nei capitoli dei prodotti chimici HYCARE)
• Aggiustare, correggere e/o modificare il pre-trattamento.

Prevenzione:
Esistono vari modi per prevenire lo sporcamento colloidale:
• Sostituire le tubazioni e i raccordi corrosi, con materiali appropriati.
• Pre-filtrazione: le particelle colloidali possono essere rimosse con vari sistemi di pre-filtrazione (contattare l' ufficio tecnico Hytek).
• Impaccamento: rimuovere ferro e sostanze colloidali
• Resina cationica forte per addolcimento: rimuove ferro e alluminio (prego contattare l' ufficio tecnico Hytek)
• Considerazioni operative: un blando pre-trattamento può essere compensato con lavaggi chimici più frequenti.

Symptoms of Trouble:
Trouble with colloidal fouling of a RO/NF system normally means at least one of the following:
• Loss of normalized permeate flow rate: in practice this is normally seen as a feed pressure increase in order to maintain the permeate output.
• Increase in normalized solute passage: in RO this is typically increased permeate conductivity.
• Increase in pressure drop: the difference between feed pressure and concentrate pressure at constant flow rate becomes larger.

Removal:
• Clean the elements depending on foulant (details of cleaning procedures for colloidal fouling are available on chapters of the HYCARE chemical products).
• Adjust, correct and/or modify the pre-treatment.

Prevention:
there are several ways to control colloidal fouling:
• Retrofit corroded piping or system components with appropriate metallurgy
• Pre-filtration: colloidal particles can be removed using a variety of filtering methods as pre-filtration (please contact Hytek technical offices).
• Lime softening: removes iron and colloidal matter.
• Strong acid cation exchange resin softening: removes iron and aluminum (please contact Hytek technical office).
• Operational considerations: A poor pre-treatment can be partially compensated by more frequent and/or harsh cleaning.

RISOLUZONE DEI PROBLEMI:"SPORCAMENTO DA OSSIDI METALLICI"/: TROUBLESHOOTING "METAL OXIDE"

Ossidi di metallo:
L' inquinamento da ossidi metallici è uno sporcamento che deriva dalla concentrazione sulla superficie della membrana di metalli ossidati e di solfati. Esso può danneggiare seriamente le performance dell' impianto abbassando la produttività e qualche volta anche la reiezione salina.
Cause: derivano dalla presenza nell' acqua di ossidi metallici quali ferro e alluminio o dalla corrosione di raccordi, vessels o componenti presenti a monte delle membrane. I solfati metallici, vengono prodotti dall' ossidazione dell' idrogeno solforato grazie all' azione ossidante dell' aria. Nel permeato tale ossidazione porta alla formazione di sulfuri.
Identificazione:
• Un semplice segnale di sporcamento da metalli e dato dall' aumento delle perdite di carico attraverso il sistema RO.
• L' inquinamento da ossidi metallici avviene generalmente nel primo stadio dove le membrane catturano i solidi precipitati. Il problema è di facile localizzazione quando vengono previsti dei flussimetri su ogni stadio.
• L' inquinamento da ossidi metallici è facilmente visibile-vedi foto sotto. Ispezionare ed analizzare i depositi sulla membrana srotolata del primo stadio.
• L' entità dell' inquinamento può essere determinato pesando la membrana.
• Analizzare l' acqua di alimento per identificare ferro e alluminio.
• Controllare che i componenti dell' impianto non siano sogetti a corrosione

Metal Oxide
Metal oxide fouling is another form of filtration fouling and is the accumulation of insoluble metal oxides or sulfides on the RO elements.
It can seriously impair performance by lowering productivity and sometimes salt rejection.
Causes: Metal oxides form iron or aluminum in the feedwater or corrosion of piping, vessels, or components upstream of membrane elements.
Metal sulfides are produced when hydrogen sulfide reacts with air in the feedwater. Reaction with air in the permeate results in elemental sulfur formation.
Identification:
• An early sign of metal oxide fouling is often an increased pressure differential across the system.
• Metal oxide fouling usually occurs in the first stage, where the lead elements trap the solids.
The problem is easier to localize when permeate flow meters are installed in each array.
• Metal oxide fouling is often visible - see photographs below. Inspect and analyze deposits on feed scroll end of first stage lead elements.
• The extent of metal oxide fouling can be determined by weighing the lead element.
• Analyze feedwater for iron and aluminium
• Check system components for evidence of corrosion

- In questi elementi si nota che i depositi di ruggine dovuti al ferro, non solo colpiscono le prime membrane, ma anche le successive (vedi terza membrana in alto a destra). Anche se l' inquinamento è molto più severo sul primo elemento, questo dimostra che è possibile contaminare il sistema colpendo tutti gli elementi. Possono così essere inquinate sia la 2^ fino alla 6^ membrana e il problema è possibile rilevarlo anche nel 2° e 3° stadio.
-These elements show that iron rust deposits affect not only the lead elements in a pressure vessel on the left hand side, but also the tail element in the upper right hand corner of the photograph. Although the particle fouling is most severe on the first element, this demonstrates that it is possible to contaminate the system throughout and affect elements in positions 2 to 6 and even further into the second and third array.

- Questo elemento è pesantemente inquinato da ruggine od ossido di ferro ed almeno un folglio della membrana è stato spinto in profondità. Ciò permette allo sporco di penetrare lungo tutta la membrana. Nella prossima fotografia si vede questo stesso elemento srotolato.
- This element is heavily fouled with rust or iron oxide salts and at least one membrane envelope has been pushed deeper into the membrane spiral configuration thus allowing particles to penetrate deeper into the spiral membrane. The next photograph shows this same element unrolled.

- Qui viene illustrato un foglio di membrana e, come si vede, il deposito di ferro è uniforme su tutta la superficie. In particolare sull' alimento (deposito marrone più scuro sul lato sinistro) lo sporco è più intenso, mentre sul lato destro (concentrato) lo sporco è meno intenso.
- One of the membrane envelopes is displayed here and shows that the iron contamination is throughout the whole membrane envelope with a thick, deep brown deposit on the left hand (feed) side and a light brown deposit on the right hand (concentrate) side of the membrane.

- Al fine di comprendere quanto la superficie della membrana è stata inquinata, si è utilizzata una spazzola per rimuovere lo sporco. Come si può notare, sotto lo sporco, la membrana appare ancora integra e non danneggiata con il suo classico colore bianco chiaro.
- In order to investigate how much the underlying membrane substrate is affected by the particle fouling, a brush is used and the foulant is wiped away. Underneath the foulant it seems that there is still the relatively unharmed white membrane substrate.

Problemi e sintomi:
I problemi causati dall' inquinamento da ossidi metallici sugli impianti RO/NF sono di solito i seguenti:
• Basso flusso di permeato rispetto alle condizioni normalizzate; questo di solito si riscontra quando occorre aumentare la pressione dell' impianto per produrre la stessa quantità d' acqua.
• Incremento della salinità sul permeato; nell' impianto RO significa un' aumento della conducibilità dell' acqua permeata.
• Incremento delle perdite di carico: a flusso costante la differenza tra la pressione in ingresso e quella sul concentrato diventa sempre più grande.

Rimozione:
• La pulizia degli elementi dipende dal tipo di sporcamento (può trovare i dettagli sui lavaggi chimici contro lo sporcamento colloidale nei capitoli dei prodotti chimici Hytek)
• Aggiustare, correggere e/o modificare il pre-trattamento.

Prevenzione:
Esistono vari modi per prevenire lo sporcamento colloidale:
• Sostituire le tubazioni e i raccordi corrosi, con materiali appropriati.
• Pre-filtrazione: gli ossidi metallici possono essere rimossi con vari sistemi di pre-filtrazione (contattare l' ufficio tecnico Hytek).
• Trattamenti a calce: rimuovono ferro e ossidi metallici (prego contattare l' ufficio tecnico Hytek).
• Resina cationica forte per addolcimento: rimuove ferro e alluminio (prego contattare l' ufficio tecnico Hytek)

Symptoms of Trouble:
Trouble with metal oxide fouling of a RO/NF system normally means at least one of the following:
• Loss of normalized permeate flow rate; in practice this is normally seen as a feed pressure increase in order to maintain the permeate output.
• Increase in normalized solute passage; in RO this is typically increased permeate conductivity.
• Increase in pressure drop: the difference between feed pressure and concentrate pressure at constant flow rate becomes larger.

Removal:
• Clean the elements depending on foulant (details of cleaning procedures for colloidal fouling are available on chapters of the Hytek chemical products).
• Adjust, correct and/or modify the pre-treatment.

Prevention:
there are several ways to control metal oxide fouling:
• Retrofit corroded piping or system components with appropriate metallurgy
• Pre-filtration: metal oxide particles can be removed using a variety of filtering methods as pre-filtration (please contact Hytek technical offices).
• Lime softening: removes iron and metal oxide matter (please contact Hytek technical office).
• Strong acid cation exchange resin softening: removes iron and aluminum (please contact Hytek technical office).

RISOLUZONE DEI PROBLEMI:"SPORCAMENTO ORGANICO"/: TROUBLESHOOTING "ORGANIC FOULING"

Sporcamento organico

L'assorbimento di sostanze organiche sulla superficie della membrana, causa una perdita di flusso che, nei casi più seri, può diventare irreversibile. Il processo di assorbimento è favorito da pesi molecolari alti, da composti idrofobici o composti caricati positivamente. Nelle acque naturali i composti organici sono solitamente sotto forma di sostanze umiche in concentrazioni che vanno dagli 0.5 ai 20 mg/L TOC. Altri inquinanti organici sono il petrolio, il grasso e i polielettroliti.

Cause: sono soprattutto una combinazione di alto carico organico e un pre-trattamento improprio. Gli organici si presentano come un'emulsione che può formare sulla membrana un film organico. Esso deve essere rimosso con un pre-trattamento.

Identificazione:

L' inquinamento organico viene rilevato nella variazione dei parametri di funzionamento dell' impianto, generalmente nel primo stadio:

- L' inquinamento organico non è così frequentemente visibile e distinguibile.
- Analizzare i depositi sulle cartucce filtranti e il filtrino dell' SDI.
- Analizzare l' acqua in alimento per presenza di petrolio e contaminanti organici
- Verificare i coagulanti del pre-trattamento, in particolar modo i polielettroliti cationici.
- Verificare i detergenti ed i tensioattivi.

Organic fouling

Adsorption of organic substances on the membrane surface causes flux loss, which is irreversible in serious cases. The adsorption process is favored with high molecular weight, hydrophobic or positively charged compounds. Organics occurring in natural waters are usually humic substances in concentrations between 0.5 and 20 mg/L TOC. Other organic foulants include oil, grease and polyelectrolytes.

Causes: mostly a combination of high organically laden and improper pre-treatment.

Organics present as an emulsion may form an organic film on the membrane surface and must therefore be removed in the pre-treatment.

Identification:

Organic fouling of the membranes is indicated by the following changes in the operating parameters, predominantly in the first stage of the system:

- Organic fouling is not frequently visible- see photograph below.
- Analyze deposits from filter cartridges and SDI filter pads
- Analyze the incoming water for oil and organic contaminates
- Check pre-treatment coagulants, especially cationic polyelectrolytes
- Check cleaning detergents and surfactants

- In molti casi, l' inquinamento organico non è visibile sulla superficie della membrana. La fotografia sopra è un caso eccezionale in quanto la materia organica è precipitata per un dosaggio eccessivo di antiscalante che si è combinato con sali di ferro ed alluminio. Visivamente questo inquinamento può essere scambiato come inquinamento biologico (biofoluling).
- In many cases, organic fouling is not visible on the membrane surface. The photograph is a special case with antiscalant, where either antiscalant overdosing or reaction with iron or aluminium salts caused a precipitation on the membrane. Optically it may be virtually indistinguishable from biofouling.

Problemi e sintomi:

I problemi causati dall' inquinamento organico sugli impianti RO/NF sono di solito i seguenti:

• L'assorbimento di materiale organico sulla superficie della membrana, causa una riduzione del flusso di permeato rispetto alle condizioni normalizzate, più di frequente nel primo stadio. Questo è riscontrabile quando occorre aumentare la pressione dell' impianto per produrre la stessa quantità d' acqua. Nei casi più seri, questo tipo di inquinamento è irreversibile.

• Il deposito organico sulla membrana, agisce sia come una barriera supplementare per i sali disciolti, che come tappo. Questo comporta una diminuzione del passaggio salino, soprattutto quando sono presenti organici con alto peso molecolare, o organici idrofobi, o organici con gruppi cationici, oli o polielettroliti cationici.

Rimozione:

Per i dettagli sui lavaggi chimici, vedere capitoli dei prodotti chimici Hytek

• Pulizia degli organici. Molti organici possono essere lavati con successo, altri invece no (esempio gli oli combustibili)

• Pre-trattamento adeguato: usare un dosaggio minimo di coagulante; monitorare sempre l' acqua di alimento per evitare dosaggi eccessivi. In molti casi la rimozione dell' organico sulla superficie della membrana è molto difficile.

Prevenzione:

Ci sono molti modi per controllare lo sporcamento organico:

• Deve sempre essere previsto un pre-trattamento quando l' acqua di alimento ha un TOC > 3 mg/L.

• Alti valori di pH aiutano a prevenire lo sporcamento, poiche sia la membrana che molti composti organici assumono una carica negativa a pH > 9.

• Sostanze umiche possono essere rimosse tramite una coagulazione con flocculanti idrossidi, con ultrafiltrazione o tramite adsorbimento su carboni attivi. E' possibile rimuovere anche colori con alto peso molecolare utilizzando membrane nanofiltrazione FILMTEC™

• Coagulazione o carboni attivi devono essere previsti in presenza di oli (a base idrocarburo o silicone) e in presenza di grassi in concentrazioni > 0.1 mg/L. Queste sostanze vengono facilmente assorbite dalla membrana, tuttavia possono essere eliminate con un tempestivo lavaggio alcalino, ovvero il flusso non deve diminuire più del 15% rispetto alle condizioni normalizzate.

• Modificare il pre-trattamento e i separatori di oli. Nelle acque di scarico il principale obiettivo deve essere la reiezione e la concentrazione degli organici.

Symptoms of Trouble:

Trouble with organic fouling of a RO/NF system normally means at least one of the following:

• The adsorption of organic matter present in the feed water on the membrane surface causes loss of normalized permeate flow rate, especially in the first stage. In practice this is normally seen as a feed pressure increase in order to maintain the permeate output.
This may be irreversible in serious cases.

• An organic adsorption layer acts as an additional barrier for dissolved salts or plugs pinholes of the membrane, resulting in a lower salt passage, especially organics with a high molecular weight, hydrophobic or cationic groups e.g. oil traces or cationic polyelectrolytes, which are sometimes used in the pre-treatment.

Removal:

For details of cleaning procedures, see chapters of the Hytek chemical products

• Clean for organics. Some organics can be cleaned successfully, some cannot (e.g. heating oil)

• Correct the pre-treatment: use minimal coagulant dosages; monitor feedwater changes to avoid overdosing. In many cases, the organics are very difficult to remove from the membrane surface.

Prevention:

There are several ways to control organic fouling:

• Pre-treatment should be considered when TOC in the feedwater > 3 mg/L.

• A high pH value helps to prevent fouling, as both the membrane and many organic substances assume a negative charge at pH > 9.

• Humic substances can be removed by a coagulation process with hydroxide flocs, by ultrafiltration or adsorption onto activated carbon. Removal of color from high molecular weight organic is also possible by FILMTEC™ nanofiltration membranes.

• Coagulation or activated carbon must also be applied when oils (hydrocarbons or silicone-based) and greases contaminate the RO feed water at levels > 0.1 mg/L.
These substances are readily adsorbed onto the membrane surface. They can be cleaned off, however, with alkaline cleaning agents if the flux has not declined by more than 15%.

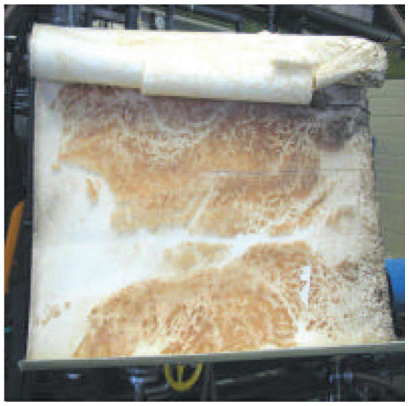
• Modify the pre-treatment, i.e. oil//water separators. In waste water applications, the rejection and concentration of organics is a major objective.

RISOLUZONE DEI PROBLEMI:"SPORCAMENTO INORGANICO"/: TROUBLESHOOTING "SCALING"

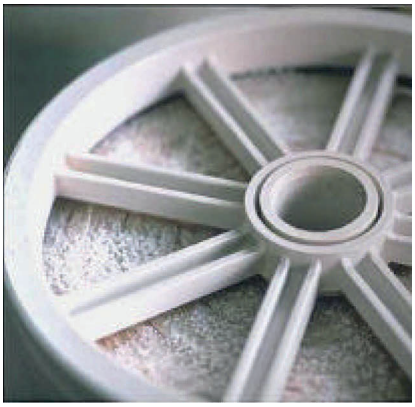
Sporcamento inorganico
La sporcamento inorganico è un problema chimico dell' acqua causato dalla precipitazione di sali poco solubili come il CaCO3, il calcio, lo stronzio o il solfato di bario, sopra la superficie della membrana.
Causa: è generalmente da ricercare in recuperi troppo spinti o in una pre-filtrazione non adeguata (se il dosaggio dell' acido o dell' antiscalante in alimento è scarso o inesistente). La precipitazione inorganica avviene di norma sulle ultime membrane dove la concentrazione ionica è maggiore; col tempo questo tende a spostarsi verso i primi elementi. Acque con alti tenori di calcio, bicarbonati e/o solfati, possono dare origine a precipitati, anche in tempi ridotti e con membrane nuove. Le precipitazioni di sali come il bario e il fluoro sono molto lente, a causa delle loro basse concentrazioni nelle acque.
Identificazione:
• L' inquinamento inorganico è spesso visibile e avvertibile anche all' interno del vessel - vedi foto sotto.
• Un inquinamento importante è rilevabile pesando la membrana ed è soprattutto localizzato nella sua parte finale.
• Eseguire un'autopsia della coda della membrana e controllare con un microscopio i depositi salini. Il tipo di precipitazione può essere identificata da un chimico o tramite un' analisi a raggi X. Se la reazione del precipitato con acido genera schiuma, vuol dire che siamo in presenza di carbonati (vedi foto). L' inquinamento da carbonati è molto comune.
• La precpitazione può causare danni meccanici alla membrana come la telescopicizzazione e/o danneggiamenti alla vetroresina per eccessiva perdita di carico.

Scaling
Scaling is a water chemistry problem originating from the precipitation and deposition of sparingly soluble salts, such as CaCO3, calcium, strontium or barium sulfates onto the membrane surface.
Causes: typical causes are a system operated at higher than intended recovery or improper pre-filtration (if acid dosing or anti-scalant dosing failed).
Scaling usually starts in the last stage, where ionic concentrations are highest, and then moves gradually to the upstream stages. Feed waters with high levels of calcium, bicarbonate and/or sulfate can scale even a new membrane system within hours. Barium or fluoride scaling is normally slow, due to the low concentrations involved.
Identification:
• Scale is often visible and can also be felt on the inside of the pressure vessel - see photographs below.
• The extent of scaling can be determined by weighing the tail element.
• Run a tail element autopsy to check for crystalline deposits under a microscope. The type of scaling is identified by a chemical or X-ray analysis.
A foaming reaction with acid indicates carbonate scaling (see photograph). Calcium carbonate is a very common scale.
• Scaling can also cause mechanical damage to the membrane element such as telescoping and fiberglass damage from excessive pressure drop.

- Questa foto mostra la reazione dell' acido sopra una superficie di una membrana inquinata inorganicamente. La schiuma è dovuta alla liberazione di anidride carbonica ed indica la presenza di carbonati.
- This picture shows the reaction of acid on the surface of a membrane that is scaled. The foaming is due to carbon dioxide release and indicates that carbonate scale is present.



- La foto mostra la presenza di carbonato di calcio e cristalli di ferro precipitati sugli spaziatori. Questo inquinamento causa danni ai fogli semipermeabili della membrana. L'area mostrata a sinistra è relativamente chiara poichè rappresenta l' unico spazio dove l' acqua poteva ancora permeare. Come si può notare il flusso di acqua scorreva da sinistra verso destra ed è ben evidenziata una zona bianca preferenziale dove il flusso ha scongiurato la precipitazione.
- This is a calcium carbonate iron crystal growth in the feed spacer causing damage to the membrane envelopes. The area on the lower left-hand side is relatively clear, where water could still pass through the membrane. The water flow is from left to right and a small open flow channel can be seen through this heavily fouled element.



- In questo caso lo sporcamento salino ha inziato a depositarsi fuori dalla membrana in prossimità dei suoi raggi. Il colore e la forma dei cristalli, variano in base al tipo di inorganico precipitato.
- In this case the scalant has started to protrude and grow out of the element and crystals can be seen growing between the spokes of the anti-telescoping device. The color and crystal shapes vary for inorganic salts typically found as scalants in RO systems.

- In questa foto, si nota che la precipitazione avenuta sulla superficie della membrana porta le impronte degli spaziatori . L'area centrale è stata grattata per mostrare l' importanza dell' inquinamento; infatti esso si mostra molto profondo e denso, tipico del carbonato e solfato di calcio. I progettisti di impiantoi RO dovrebbero conoscere la pericolosità di un impianto sprovvisto di dosaggio di antiscalante. L' inquinamento inorganico, può formarsi rapidamente e può divenire la base per una precipitazione salina sotto forma di cristalli. Questo porta a flussi anomali all' interno della membrana con aumento di precipitazione.
- This close-up of membrane surface scale has the imprint of the feed channel spacer. The area in the middle has been scratched clean to show how deep and dense the scaling layer is, typical of calcium carbonate and sulfate scales. Membrane plant operators should be aware of the danger of running an RO plant without antiscalant if it is needed, as tiny crystals can form in a short time and act as initiator for further crystal growth. This then leads to flow disturbances causing further scaling.

- L' impronta lasciata su questa precipitazione inorganica, mostra l' effetto bariera dello spaziatore. Si nota come l' inquinamento sia più pronunciato a valle della membrana a causa dei flussi lenti ed anomali formatisi. Questo mette in risalto l' importanza di avere sempre un flusso minimo di concentrato al di sotto del quale i sali raggiungerebbero la saturazione con conseguente precipitazione.
- The feed spacer imprint on this scaling shows the barrier effect of the spacer and how scaling is more pronounced directly downstream of the spacer barriers, due to turbulences and local flow distributions within the feed channel spacer. It also highlights the importance of maintaining a minimum brine flow rate, especially with high recovery, as this helps to inhibit over-saturation and flush contaminants out of the system.

Problemi e sintomi:
I problemi causati dall' inquinamento inorganico sugli impianti RO/NF sono di solito i seguenti:
• Basso flusso di permeato rispetto alle condizioni normalizzate; questo di solito si riscontra quando occorre aumentare la pressione dell' impianto per produrre la stessa quantità d' acqua.
• Incremento della salinità sul permeato; nell' impianto RO significa un' aumento della conducibilità dell' acqua permeata.
• Incremento delle perdite di carico: a flusso costante la differenza tra la pressione in ingresso e quella sul concentrato diventa sempre più grande.
Rimozione:
Lavare con acido e/o agenti chelanti alcalini come EDTA possibilmente ad alta temperatura. Analizzare la soluzione consumata per verificare gli effetti del lavaggio. Da notare che in certe nazioni non è consentito scaricare l' EDTA:
• Inquinamento da carbonati: usare lavaggi acidi.
• Inquinamento da solfati: usare EDTA alcalino.
• Inquinamento da fluoruri: usare EDTA alcalino.
• Per altri inquinamenti diversi dal carbonato di calcio, lavare con EDTA a pH 12.
Prevenzione:
ci sono molti modi per controllare la precipitazione:
• Analizzare il potenziale di precipitazione dell' acqua e dimensionare correttamente il recupero del sistema.
• Analizzare l' acqua in alimento, il permeato e il concentrato per quanto riguarda calcio, bario, solfati, fluoruri, silicati, pH e LSI (S & DSI per acqua di mare). Calcolare l' equilibrio di massa di questi elementi. Calcolare il prodotto di solubilità dei sali poco solubili e della silice nel concentrato.
• Verificare il concentrato per evidenti sintomi di precipitazione.
• Dosare acido o antiscalante (inibitori di precipitazione) in riferimento alle caratteristiche chimiche dell' acqua. Gli antiscalanti agiscono sulla superficie dei micro-cristalli, prevengono la proliferazione e la precipitazione dei cristalli. Per l' antiscalante più idoneo, prego vedere capitolo dei prodotti chimici HYCARE.
• Rimuovere a monte ioni problematici come Ca, Sr, Ba con addolcitore o calce (per impianti di acqua salmastra > 200 m3/h (880 gpm)).
• Prevedere sempre un flussaggio.
• Diminuire i recuperi per eliminare i rischi di precipitazione.

Symptoms of Trouble:
Trouble with scaling of a RO/NF system normally means at least one of the following:
• Loss of normalized permeate flow rate; in practice this is normally seen as a feed pressure increase in order to maintain the permeate output.
• Increase in normalized solute passage; in RO this is typically increased permeate conductivity.
• Increase in pressure drop: the difference between feed pressure and concentrate pressure at constant flow rate becomes larger.
Removal:
Clean with acid and/or alkaline chelating agent such as EDTA at elevated temperature if possible. Analyze the spent solution to check cleaning effect. Note that EDTA discharge into the environment is not permitted in certain countries:
• Carbonate Scale: use acid cleaning.
• Sulfate Scale: use alkaline EDTA.
• Fluoride scaling: use alkaline EDTA.
• For other scales, that are not calcium carbonate, clean at pH 12 with EDTA
Prevention:
there are several ways to control scaling:
• Check feedwater analysis for scaling potential at prevailing system recovery.
• Analyze feed water, permeate and concentrate for calcium, barium, strontium, sulfate, fluoride, silicate, pH and LSI (S&DSI for sea water). Try to calculate the mass balance for these salts. Calculate the solubility products of sparingly soluble salts and silica in the concentrate.
• Inspect concentrate side of system for signs of scaling.
• Add acid or antiscalant chemicals (scale inhibitors) according to water chemistry in the concentrate. Antiscalants adsorb onto the surface of microcrystals, preventing further crystal growth and precipitation.
For appropriate antiscalants please see HYCARE chemicals chapter.
• Removing the problem ions (Ca, Sr, Ba) upfront with an ion exchange softener or a lime softener (for larger brackish water plants > 200 m3/h (880 gpm)).
• Preventative regular cleaning/flushing.
• Lowering the recovery to eliminate the risk of precipitation.

RISOLUZONE DEI PROBLEMI:"TELESCOPICIZZAZIONE"/: TROUBLESHOOTING "TELESCOPING"

Telescopicizzazione

La telescopicizzazione è un danneggiamento di tipo meccanico dove gli strati più esterni della membrana slittano verso il concentrato rendendo il modulo RO simile ad un telescopio.

Cause: la telescopicizzazione ha origine da una scorretta installazione o da una scorretta conduzione dell' impianto RO/NF.

• Pressione in ingresso troppo elevata, alte temperature o colpi di ariete sono tra le cause più frequenti che portano alla telescopicizzazione

• Se c' è un aumento delle perdite di carico, succede che lo spaziatore tende a scivolare fuori dalla propria sede traslando verso il lato concentrato. Se le forze diventano eccessive e le perdite di carico aumentano oltre i livelli raccomandati, il fenomeno della telescopicizzazione è inevitabile.

• La mancanza o l' errata installazione di o-ring, possono causare il fenomeno della telescopicizzazione.

Identificazione:

• Sono ben visibili i danneggiamenti di tipo meccanico - vedi fotografie sotto.

• La telescopicizzazione può essere scoperta con una sonda oppure con un test di fuga.

Telescoping

Telescoping is a type of membrane mechanical damage where the outer membrane layers unravel and extend downstream past the remaining layers in a telescope-like fashion.

Causes: telescoping originates mostly from incorrect installation or operation of the RO/NF elements:

• Too high feed pressure, temperature or a water hammer, are the main causes of telescoping.

• If the differential pressure increases, a typical result is a dislodged feed channel spacer protruding out of the membrane elements. If the forces become excessive and differential pressure increases to above recommended levels then telescoping usually occurs.

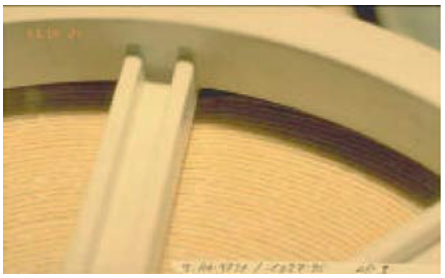
• Omitted or wrongly installed thrust rings will also cause telescoping.

Identification:

• Mechanical damage to the elements is visible - see photographs below.

• Telescoping can be identified by probing and confirmed by a leak test.

- Questa fotografia mostra un danno da telescopicizzazzione, dove il tappo della membrana è stato staccato dall' avvolgimento in vetroresina. La parte centrale della spirale viene spinta verso il lato concentrato da un flusso in ingresso troppo elevato.
- This photograph shows telescoping damage, where the anti-telescoping device has been pushed out of the element and separated from the fiberglass. The middle section of the spiral wound element protrudes out of the spiral and moves towards the concentrate side. This is due to the high flow rate of feed water close to the product water tube.



- Questa foto mostra il danno da telescopicizzazione su una membrana da 8". La spirale avvolta è stata spinta verso il concentrato staccandosi dal tappo. Una volta rimosso il tappo, il fenomeno è facilmente visibile, come mostrato nella figura sotto.
- This shows telescoping damage in an 8 inch element. The spiral wound configuration has been pushed into the anti-telescoping device. When the end-cap anti-telescoping device is removed from the element the damage becomes even more obvious as shown in the next photograph.

- Con la rimozione del tappo si nota chiaramente il segno lasciato dai raggi dal tappo posto nel lato concentrato.
- With the end-cap removed, the imprint of the spokes from the anti-telescoping device shows clearly on the spiral configuration.

- Nei casi più estremi, le eccessive forze meccaniche causate dal flusso in ingresso, arrivano a rompere il tappo.
- In more severe cases the anti-telescoping device starts to break due to the excessive mechanical forces present.

Problemi e sintomi:

• La telescopicizzazione causa un aumento del passaggio salino rispetto alle condizioni normalizzate e un perdita di pressione

Azioni Correttive

Sostituire le membrane danneggiate e risolvere i problemi:

• Una telescopicizzazione modesta non danneggia necessariamente la membrana, ma nei casi più estremi la colla della membrana si stacca rendendo l' elemento inutilizzabile.

• Installare correttamente gli o-rings in alimento

• Verificare tubi, adattatori, interconnettori e o-rings, sostituendo le parti danneggiate.

Prevenzione:

Correggere le condizioni operative dell' impianto che portano a pressioni elevate o colpi di ariete.

Symptoms of Trouble:

• Telescoping causes an increase in the normalized solute passage and pressure drop.

Corrective actions:

Replace the damaged element(s) and correct the causes:

• Modest telescoping does not necessarily damage the membrane, but in more severe cases the glue line and/or membrane can be ruptured and must be replaced.

• Install thrust rings correctly.

• Check other components (water tubes, adaptors, interconnectors, O-rings) and replace if damaged.

Prevention:

correct the operating conditions to eliminate high pressures/water hammer.

RISOLUZONE DEI PROBLEMI:"COLPI DI ARIETE"/: TROUBLESHOOTING "WATER HAMMER"

Colpi di ariete

I colpi di ariete, sono shock idraulici che si verificano sull' impianto e che possono causare danni meccanici importanti sia sulle membrane che sugli altri componenti (o-rings, tubo permeato, guscio in vetroresina della membrana).

Cause: hanno origine da installazioni non corrette o conduzioni sbagliate dell' impianto RO/NF:

• Uno stat-up troppo violento dove la pompa di alimento è stata mandata immediatamente in pressione, oppure una fermata troppo rapida dell' impianto, spingono l' aria ancora presente nelle tubazioni dentro le membrane.

• Gli effetti drammatici di un colpo di ariete aumentano in presenza di sporcamento (generalmente biologico), a causa dell' intasamento dei canali di alimentazione della membrana.

• Allo start-up, l ' aria presente nei vessels, può essere spinta violentemente dalla pressione in alimento nella membrana danneggiandola irreversibilmente.

Identificazione:

• Il colpo di ariete sulle membrane è visibile come da fotografie sotto. Esso può causare telescopicizzazione, compressione dei fogli semipermeabili (compattazione), rottura del tubo permeato o rottura del guscio in vetroresina.

• Telescopicizzazione, lacerazione delle membrane e rottura del tubo permeato, possono essere identificati con sonde o test di fuga.

Water hammer

Water hammer is an hydraulic shock to the system, that can lead to severe mechanical damage to the membrane elements and other components (O-rings, product water tube, epoxy shell).

Causes: mostly originate from incorrect installation or operation of the RO/NF elements:

• An instant hard-start of a high pressure pump against a system which has not been fully vented before e.g. at initial or operational start-ups, when the system has been allowed to drain and air is still present.

• The water hammer effect is dramatically increased when fouling is present (especially biofilm), due to blockage of the feed channels.

• The presence of air in the pressure vessels on start-up can also cause element damage due to expansion as the feed pressure is applied.

Identification:

• Water hammer damage to the elements is visible -see photographs below. It can lead to membrane telescoping, compression of the membrane leaves (membrane compaction), cracked product water tube or epoxy shell.

• Telescoping, torn membranes and cracked product water tube leaks can be identified by probing and confirmed by a leak test.

- La rottura del guscio in vetroresina è stato causato da una conduzione impropria dell' impianto. Le cause sono da ricercare in un colpo di ariete oppure da una differenza di pressione troppo elevata tra alimento e lato concentrato.
- Cracking of the fiberglass shell as shown can only be caused by improper operation of the membrane element - in particular by a pressure shock or a too high pressure differential between feed and concentrate side from a water hammer.

- In questa foto è ben visibile il danno causato da un colpo di ariete. Si nota come la membrana si sia rotta nel punto più debole ovvero tra il tappo e la fine del guscio in vetroresina. Un impianto ben dimensionato e progettato, dovrebbe evitare rischi simili.
- Here, the force of a water hammer has caused the fiberglass to break at the weakest point - the connection of the fiberglass to the anti-telescoping end-cap device. With the new flush-end designed elements, such damage has become rare.

- Questa fotografia di una membrana da 8", mostra il danno causato dal rapido incremento della pressione in alimento al momento dello start-up. Le fessure longitudinali del guscio in vetroresina, sono causate dall' aria presente nelle tubazioni che non è stata opportunamente rimossa.
- This photograph shows the typical longitudinal cracks of fiberglass in an 8 inch element due to ramping the feed pressure up too quickly before all the air has been removed from the vessel. The element expands outwards as the pressure is applied.

- Questa foto mostra gli effetti estremi di un colpo di ariete e di una telescopicizzazione. Lo sbalzo di pressione ha distrutto il guscio in vetroresina con rottura della membrana. Il taglio che si vede sulla parte sinistra della foto, è una sezione fatta artificialmente per eseguire un' analisi di fluorescenza con raggi X.
- This shows the extreme effects of water hammer and telescoping. The water hammer destroyed the fiberglass shell and the membrane cracked. The wedge cut out on the left hand side of the element is not membrane damage, but was made for an x-ray fluorescence analysis.

Problemi e sintomi:

• La telescopicizzazione e la lacerazione delle membrane causano un aumento sia della salinità che delle perdite di carico.

• La compattazione della membrana causa sia una riduzione della salinità che del flusso di permeato.

• La rottura del tubo permeato comporta un' aumento della salinità e del flusso del permeato.

Azioni Correttive

• Sostituire le membrane danneggiate.

• Verificare tubi, adattatori, interconnettori e o-rings, sostituendo le parti danneggiate.

• La pompa di alimento può essere danneggiata dalla cavitazione. Ripararla o sostituirla.

• Verificare la tenuta dell' impianto e verificare le valvole.

Prevenzione:

Per evitare il danneggiamento della membrana:

• La pressione in alimento deve essere aumentata lentamente prima di arrivare a regime per permettere lo spurgo d' aria.

• Assicurarsi che al fermo impianto i vessels non siano a pressione negativa (installare una valvola contro il vuoto).

• Se la linea di scarico del concentrato è posizionata al di sotto dei vessels, deve essere installata una valvola anti-aria ad un livello più alto dei vessels per evitare fenomeni di stagnazione di bolle all' interno delle membrane.

• Per evitare fenomeni di compattazione della membrana e danneggiamenti al tubo permeato, correggere le condizioni operative dell' impianto eliminando le alte pressioni e i colpi di ariete.

Symptoms of Trouble:

• Telescoping and torn membranes cause increases in the normalized solute passage and pressure drop.

• Membrane compaction causes a reduction in normalized solute passage and permeate flow.

• Cracked product water tube result in increased normalized solute passage and permeate flow.

Corrective actions:

• Replace damaged elements.

• Check other components such as water tubes, adaptors, interconnectors and O-rings and replace if damaged.

• The high pressure pump can be damaged by cavitation. Repair or replace.

• Check isolating and check-valves for leaks.

Prevention:

there are several ways to control membrane damage:

• Feed pressure should always be increased very slowly to allow any trapped air in the system to escape.

• Ensure that the pressure vessels are not under vacuum when the plant is shut down (e.g. by installation of a vacuum breaker).

• If the concentrate line drain is below the level of the pressure vessels, an air break should be installed in the line at a higher position than the pressure vessels to avoid the vessels draining by a siphoning effect.

• To avoid membrane compaction and glue line or product water tube damage, correct operating conditions to eliminate high pressures/water hammer.

RISOLUZONE DEI PROBLEMI:"PERDITE DA O-RINGS E TENUTE"/: TROUBLESHOOTING "LEAKING O-RINGS AND SEALS"

Perdite da o-rings e tenute

Gli o-rings possono perdere se messi a contatto con agenti chimici aggressivi oppure dopo stress meccanici importanti o colpi di ariete. La corretta installazione delle membrane nei vessels, è condizione indispensabile per ridurre al minimo l' usura degli o-ring. Può accadere che gli o-ring non vengano instalati, o vengano posizionati erroneamente o subiscano spostamenti durante la fase di montaggio delle membrane.

Cause: generalmente sono da ricercare in errate installazioni delle membrane RO/NF:

Identificazione:

La mancanza di o-rings o eventuali fughe d' acqua, possono essere identificati sull' impianto tramite l' utilizzo di sonde. Generalmente l' aumento della conducibilità avviene in prossimità dei tappi o degli adapter. Se l' aumento si rileva in mezzo alla membrana, il problema è da ricercare sull' elemento osmotico.

Problemi e sintomi:

• La mancanza di o-rings o la loro non tenuta aumenta il passaggio salino. In alcuni casi incrementa il flusso del permeato.

• La perdita dall' o-ring a labbro causa sia un' aumento della salinità sul permeato che una diminuzione del flusso permeato.

Azioni correttive:

• Controllare gli o-rings dei tappi, degli interconnettori e degli adattatori per una corretta installazione.

• Sostituire gli o-rings vecchi e danneggiati

• Prima di installare l' interconnettore, lubrificare l' ornig di tenuta con un leggero strato di silicone idoneo. La glicerina non è raccomandata in quanto dopo l' avviamento viene espulsa dall' impianto. L' applicazione di un leggero strato di lubrificante siliconico all' interno del foro delle membrane da 8" oppure sul tubo permeato delle membrane da 2,5" e 4", aiuta a tenere le membrane lubrificate per lungo tempo. Per applicazioni su acque potabili, Hytek raccomanda l' utilizzo di lubrificante siliconico Dow Corning 111 certificato e approvato FDA e NSF. Applicare sempre uno strato sottile e uniformemente distribuito sull' o-ring a labbro.

• Per perdite di tenuta sul tubo del permeato, effettuare misurazioni su ogni stadio e blocco di vessels secondo le istruzioni del produttore dei pressure vessels.

Prevenzione:

ci sono vari modi per controllare il danneggiamento delle membrane:

• Rimovere ogni causa che portano ai colpi di ariete.

• Sviluppare un programma di manutenzione per ispezionare e sostituire periodicamente gli o-ring dell' impianto.

• Sviluppare un protocollo di corretta installazione.

Leaking o-rings and seals

O-rings may leak after exposure to certain chemicals or to mechanical stress, such as element movement caused by water hammer. Proper shimming of the elements in a pressure vessel is essential to minimize the wear to the seals. Sometimes O-rings have not been installed, or they have been improperly installed or have moved out of their proper location during element loading.

Causes: mostly originates from incorrect installation or operation of the RO/NF elements:

Identification:

Leaking or missing O-rings can be identified by probing. O-ring problems are generally indicated by a step change in the conductivity profile at coupler/adapter locations, while a marked increase outside this region points to an element problem.

Symptoms of Trouble:

• Missing or leaking O-rings result in increased normalized solute passage. There may also be some increase in permeate flow.

• Leaking brine seals cause an increase in normalized solute passage. There may also be a decrease in permeate flow.

Corrective actions:

• Inspect O-rings of couplers, adaptors, and end plugs for correct installation and as-new condition.

• Replace old and damaged O-rings.

• Prior to installation of the interconnector, lubricate the O-ring seals on the interconnector with a very thin layer of silicone O-ring lubricant. Glycerin is not generally recommended as it quickly washes out during normal operation. A silicone lubricant applied sparingly to the bore of 8-inch elements or the permeate water tube outer sealing surface for 4-inch and 2.5-inch elements maintains the desired lubricity long after the initial start-up. For potable water and food processing applications, the silicone lubricant Dow Corning 111 has both FDA and NSF approval and works quite well. Apply a thin layer of silicone lubricant to each brine seal.

• For leaking or missing O-rings at the product tube on the feed end, measure the element "stack up" and shim according to the pressure vessel manufacturer's instructions.

Prevention:

there are several ways to control membrane damage:

• Remove source of water hammer if appropriate.

• Develop maintenance program to inspect and replace old O-rings.

• Develop protocol for correct installation

Linee guida per la progettazione di sistemi con membrane FILMTEC ™ di medie dimensioni / Membrane System Design guidelines for Midsize FILMTEC™ Elements

LINEE GUIDA

Le tabelle sottostanti mostrano le linee guida consigliate per la progettazione di sistemi RO semi industriali e di piccole dimensioni, tramite l' utilizzo di membrane FILMTEC ™ da 2,5 e 4 pollici.
I sistemi semi industriali in Tabella 1, hanno gli stessi requisiti dei sistemi di grandi dimensioni, che necessitano per diversi anni di prestazioni stabili. Essi sono in genere impiegati come piloti di grandi sistemi con funzionamento continuo, provvisti di strumenti per il lavaggio in loco (CIP) e nessun ricircolo del concentrato (o ricircolo minimo). La durata prevista della membrana è superiore ai 3 anni.

GUIDELINES

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. 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) concentrate recirculation. The expected membrane lifetime is more than 3 years.

Tabella 1: Linee guida per la progettazione di moduli FILMTEC ™ in applicazioni semi industriali e piccoli impianti su acqua di mare

Table 1: Design guidelines for FILMTEC™ elements in light industrial and small seawater applications

Fonte di alimentazione *Feed source*	RO Permeato *RO permeate*	Addolcita di rete *Softened Municipal*	H2O di pozzo *Well water*	H2O di superficie o di pozzo Surface or *Municipal water*
Indice SDI in alimento *Feed silt density index*	SDI < 1	SDI < 3	SDI < 3	SDI < 5
Flusso di riferimento, gfd (l/m2h) *Typical target flux, gfd (l/m2h)*	30 (51)	30 (51)	25 (42)	20 (34)
Recupero massimo membrana *Maximum element recovery %*	30	30	25	20
Portata max del permeato, gpd (m3/d) ***Max permeate flowrate, gpd (m3/d)***				
Diametro 2,5 pollici *2.5-inch diameter*	1,100 (4.2)	1,100 (4.2)	900 (3.4)	700 (2.7)
Diametro 4 pollici *4.0-inch diameter*	3,100 (11.7)	3,100 (11.7)	2,600 (9.8)	2,100 (7.9)
Portata min. del concentrato[1] (m3/h) ***Min. concentrate flowrate gpm (m3/h)***				
Diametro 2,5 pollici *2.5-inch diameter*	0.5 (0.11)	0.5 (0.11)	0.7 (0.16)	0.7 (0.16)
Diametro 4 pollici *4.0-inch diameter*	2 (0.5)	2 (0.5)	3 (0.7)	3 (0.7)

Tipo di membrana *Element type*	Area attiva ft2 (m2) *Active area ft2 (m2)*	Portata massima in alimento U.S. gpm (m3/h) *Maximum feed flowrate U.S. gpm (m3/h)*	Perdita di carico massima x membrana[1] psig (bar) *Maximum pressure drop per element1 psig (bar)*	Pression massima in alimento psig (bar) *Maximum feed pressure psig (bar)*
2540 con guscio esterno in nastro *Tape-wrapped 2540*	28 (2.6)	6 (1.4)	13 (0.9)	600 (41)
2540 con guscio in vetroresina *Fiberglased 2540*	28 (2.6)	6 (1.4)	15 (1.0)	600 (41)
2540 acqua mare *Seawater 2540*	29 (2.7)	6 (1.4)	13 (0.9)	1,000 (69)
4040 con guscio esterno in nastro *Tape-wrapped 4040*	87 (8.1)	14 (3.2)	13 (0.9)	600 (41)
TW30-4040	87 (8.1)	14 (3.2)	13 (0.9)	600 (41)
4040 con guscio in vetroresina *Fiberglased 4040*	82 (7.6)	16 (3.6)	15 (1.0)	600 (41)
4040 con guscio in vetroresina (LC) *Fiberglassed 4040 (LC)*	94 (8.7)	16 (3.6)	15 (1.0)	600 (41)
SW 4040 con guscio in vetroresina *SW Fiberglassed 4040*	80 (7.4)	16 (3.6)	15 (1.0)	1,000 (69)

[1] Per membrane nuove/pulite si raccomana di tenere la perdita di carico al di sotto del 20% rispetto al valore massimo.
[1] *We recommend that the pressure drop for new/clean elements be at least 20% below the maximum.*

Nota: i valori limite sopra elencati sono stati inseriti nel software WAVE (Water Application Value Engine).

I progetti WAVE che superano le linee guida genereranno un avviso sulla stampa finale del software.

Note: The limiting values listed above have been incorporated into the WAVE (Water Application Value Engine) software. Designs of systems in excess of the guidelines results in a warning on the WAVE printout.

Linee guida per la progettazione di sistemi con membrane FILMTEC ™ di grandi dimensioni / Membrane System Design guidelines for big size FILMTEC™ Elements

LINEE GUIDA

Il fattore che influenza maggiormente la progettazione di un sistema RO, è la tendenza dell' acqua trattata a formare incrostazioni. L' inquinamento della membrana è determinato dalla presenza di particelle e colloidi presenti nell'acqua di alimento che tendono a concentrarsi sulla superficie della stessa. L' SDI (indice di sporcamento) dell'acqua in alimento, è un indice che rende l' idea del quanttativo di materiale che può contaminare la membrana. La concentrazione dei materiali contaminanti sulla superficie del modulo FILMTEC ™, aumenta con l'aumentare del flusso di permeato (portata per unità di superficie filtrante) e con l' aumento del recupero (rapporto tra la portata del permeato e la portata in alimento per un singolo modulo osmotico). È quindi probabile che un sistema con elevate velocità di flusso sul permeato, subisca ripetute incrostazioni e lavaggi chimici frequenti.

Un sistema a membrana deve essere progettato in modo tale che ciascun elemento funzioni alle condizioni operative raccomandate per ridurre al minimo le probabilità d' incrostazione ed escludere danni meccanici. Queste condizioni operative vengono stabilite dal massimo recupero, dalla portata massima sul permeato, dalla portata minima sul concentrato e dalla portata massima in alimento su ciascun modulo osmotico. Maggiore è la tendenza all'incrostazione dell'acqua in alimento, più severi dovranno essere i limiti di questi parametri. Le linee guida raccomandate, sono basate su anni di esperienza con le membrane FILMTEC ™ e stabiliscono dei limiti verosimili.

Il flusso medio dell' inero sistema, ovvero la portata del permeato correlata alla superficie totale attiva della membrana del sistema, è un numero che caratterizza un progetto. Il flusso del sistema è un dato utile per stimare in maniera rapida il numero di membrane occorrenti per un nuovo progetto. Impianti che trattano acque in alimento di alta qualità, vengono in genere progettati con alti flussi, mentre i sistemi che funzionano con acque in alimento di scarsa qualità, vengono progettati con bassi valori di flusso. Tuttavia, anche all'interno della stessa categoria di acqua in alimento, i sistemi possono essere progettati con valori di flusso più alti o più bassi, a seconda si voglia dare priorità alla riduzione delle spese in conto capitale o alla riduzione delle spese operative a lungo termine. Gli intervalli di flusso indicati nelle seguenti tabelle, sono numeri tipici per la maggior parte degli impianti, ma non sono intesi come limiti. Un impianto RO / NF con funzionamento in continuo, con un buon pre-trattamento e progettato tenendo conto delle le linee base, evidenzierà prestazioni stabili e necessiterà circa di non più di quattro lavaggi chimici all'anno. Il superamento dei limiti raccomandati, può comportare lavaggi più frequenti, una capacità ridotta, un aumento della pressione in alimento e una durata ridotta della membrana. Una moderata e breve infrazione dei limiti può essere accettabile a condizione che non vengano superati i limiti fisici - la perdita di carico massima ammissibile e la pressione massima in alimento della membrana. D'altro canto, un approccio conservativo, consiste nel considerare una tendenza alla contaminazione più elevata e progettando il sistema secondo limiti più rigorosi per godere di un funzionamento esente da problmi assicurando altresì una maggior durata delle membrana.

Linee guida per la progettazione di sistemi a membrana per moduli FILMTEC ™ da 8 pollici

Le seguenti tabelle mostrano le linee guida consigliate per la progettazione di sistemi RO con moduli FILMTEC ™ da 8 pollici in base al tipo di acqua in alimento

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 Silt Density Index (SDI) value of the pretreated feed water correlates fairly well with the amount of fouling material present. The concentration of the fouling materials at the membrane surface increases with increasing permeate flux (the permeate flowrate per unit membrane area) and increasing FILMTEC™ element recovery (the ratio of permeate flowrate to feed flowrate for a single element). A system with high permeate flux rates is, therefore likely to experience higher fouling rates and more frequent chemical cleaning.

A membrane system should be designed such that each element of the system operates within a frame of recommended 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 flowrate, the minimum concentrate flowrate and the maximum feed flowrate per element. The higher the fouling tendency of he feed water the stricter are 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 flowrate 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 n 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

Feed source	RO permeate	Well Water	Surface water			Wastewater (Filtered Municipal Effluent or Industrial Effluent)			Seawater		
			Surface Water with DuPont Ultrafiltration	*Generic membrane filtration or advanced conventional pretreatment*	*Generic conventional pretreatment*	*DuPont Ultrafiltration*	*Generic membrane filtration (MBR/MF/UF)*	*Conventional pretreatment*	*Well or Open intake with DuPont 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, gpd or maximum permeate flux, gfd**										
365-ft2 elements	10,200	8,500	8,500	7,200	6,600	5,300	5,900	5,200	***— Not Recommended —***		
370-ft2 elements	10,200	8,500	8,500	7,200	6,600	5,300	5,900	5,200	7,800	7,400	7,000
380-ft2 elements	10,700	8,900	8,900	7,500	6,900	5,500	6,000	5,300	7,900	7,600	7,200
390-ft2 elements	10,920	9,200	***— Not Recommended —***			***— Not Recommended —***			***— Not Recommended —***		
400-ft2 elements	11,200	9,300	9,300	7,900	7,300	6,800	6,400	5,700	8,400	8,000	7,600
440-ft2 elements	12,300	10,300	10,300	8,700	8,000	7,600	7,100	6,300	9,200	8,800	8,360
Maximum element flux (gfd)	**28**	**22.7**	**22.7**	**20**	**18**	**17**	**16**	**14**	**21**	**20**	**19**
Design Flux range	**21 - 25**	**16 - 20**	**16 - 20**	**13 - 17**	**12 - 16**	**11 - 15**	**10 - 14**	**8 - 12**	**9 - 11**	**8 - 10**	**7 - 10**
Element type	**Minimum concentrate flowrate[2], gpm (m3/h)**										
BW elements (365 ft2)	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 ft2 and 440 ft2	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 —***		

Feed source	RO permeate	Well Water	Surface water			Wastewater (Filtered Municipal Effluent or Industrial Effluent)			Seawater		
			Surface Water with DuPont Ultrafiltration	*Generic membrane filtration or advanced conventional pretreatment*	*Generic conventional pretreatment*	*DuPont Ultrafiltration*	*Generic membrane filtration (MBR/MF/UF)*	*Conventional pretreatment*	*Well or Open intake with DuPont Ultrafiltration*	*Open intake with generic membrane filtration or advanced conventional pretreatment*	*Open intake with generic conventional pretreatment*
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 —		
370-ft2 elements	25 (5.7)	25 (5.7)	— Not Recommended —			— Not Recommended —			— Not Recommended —		
380-ft2 elements	10 (2.3)	NR	— Not Recommended —			— Not Recommended —			13 (3.0)	14 (3.2)	15 (3.4)
Element type Active area ft2 (m2)	**Maximum feed flowrate[2], gpm (m3/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)	75 (17)	67 (15)	61 (14)	61 (14)	61 (14)	— Not Recommended —		
BW elements 440 (40.9)	75 (17)	75 (17)	75 (17)	75 (17)	67 (15)	61 (14)	61 (14)	61 (14)	— Not Recommended —		
Fullfit 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)	73 (16)	NR	— Not Recommended —			— Not Recommended —			*70 (16)*	*66 (15)*	*62 (14)*