



Loading of Pressure Vessels

Preparation & Element Loading

Loading of Pressure Vessels

This section provides guidelines for loading and unloading FilmTec™ Reverse Osmosis (RO) and Nanofiltration (NF) Elements. For additional loading instructions, contact the individual pressure vessel manufacturer.

Preparation

A schematic diagram of the RO system should be prepared for recording pressure vessel and element locations. It should show the entire piping system for the skid as well. To identify individual element locations, use the FilmTec™ serial numbers written on each label. This diagram will help you keep track of each individual element in the system.

The following equipment is recommended:

- Safety shoes
- Safety glasses
- Rubber gloves
- Silicone lubricant (Molykote® 111 Compound recommended)
- Allen wrench
- Clean rags
- Glycerin
- Hose and water to flush vessel
- Sponge/swab, long stick and rope to clean vessel

1. Load FilmTec™ Elements into the pressure vessels just prior to start-up.
2. Before assembling all components, check the parts list and make sure all items are present and in the right quantities.
3. Carefully remove all dust, dirt, and foreign matter from the pressure vessels before opening.
4. Remove all endcap assemblies and thrust rings (if provided) from all pressure vessels in the train or system.

Note: There are several manufacturers of pressure vessels used for spiral-wound nanofiltration and reverse osmosis elements. Refer to the manufacturer's drawing for your pressure vessel during removal and installation of endcap assembly.

Element Loading (Cont.)

5. Spray clean water through the open pressure vessels to remove any dust or debris present in the vessels.

Note: If additional cleaning is required, create a swab large enough to fill the inside diameter of the pressure vessel. Soak the swab in a glycerin/water solution (50 vol%) and move it back and forth through the pressure vessel until the vessel is clean and lubricated.

Element Loading

1. Install the thrust ring in the concentrate discharge end of the vessel. Consult the manufacturer's drawing for specific information on the thrust ring positioning. This has to be done before the loading of any elements, there is a risk of not installing it properly.
2. You need to verify whether you are installing FilmTec™ Elements with iLEC™ (Interlocking Endcap) or standard elements which require the use of a supplied interconnect.
3. It's recommended to stage the elements prior to loading and record each serial number by position so that in the future you will know where each element is located inside the pressure vessel.
4. Place the leading end of the first RO or NF element into the feedwater end of the first pressure vessel and slide it in approximately one-half of the element length.
Note: Always load NF or RO elements into the feedwater end of the pressure vessel. Verify that the U-cup brine seal is properly seated in the endcap groove of the element such that the brine seal opens in the upstream direction.
5. To load standard elements: Lubricate the O-ring seals on the interconnector and the inside of the product water tube with a very thin layer of silicone lubricant. Install the interconnector into the permeate tube of the element. Glycerin may be used but is not recommended. Although glycerin lubricates during the initial installation, it quickly washes out during normal operation. Experience has shown that using 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 DuPont Corning® 111 valve lubricant and sealant, which carries both FDA and NSF approval, works quite well.
 - a. Apply a thin layer of silicone lubricant to each brine seal. When silicone is applied, as each element is installed and pushed into position this will act as a lubricant on the inside of the pressure vessel which will remain during the operation of the system making removal much easier.
 - b. Lift the next element into position and install the trailing end on the interconnector. Be very careful to hold the next element so that the weight is not supported by the interconnector, and push the element into the pressure vessel until about one-half of the element extends outside the vessel.

Element Loading (Cont.)

To load elements with *iLEC*[™] Interlocking Endcaps: A special tool is recommended which is called a ratcheting band clamp which can be ordered directly from FilmTec. The band clamp has a heavy-duty strap that grips the element securely but will not damage the element outer shell. The band clamp is lightweight, durable, and safe. It will successfully hold the element in place no matter what substance may be on the outer fiberglass shell. *Note: iLEC* elements can be connected to the end plug, one of two ways, one being a special *iLEC* adapter, the other is with a standard PV adapter. It is pressure vessel manufacturer dependant, there are slight differences in each manufacturers endplug so it's essential to make sure when the parts are ordered and prior to installation.

- a. Insert the first element, downstream end first, and push it into the vessel in the same direction as the feedwater flow. Leave enough of the element protruding from the vessel to allow attachment of the ratcheting band clamp. This is a good time to check the condition of the O-ring.
- b. *iLEC* elements with *iLEC* adapters – Attach the downstream *iLEC* adapter to the male side of the first installed (last position) element and apply a very thin layer of silicone lubricant. Begin inserting the element into the vessel leaving enough of the element protruding out for the attachment of the ratcheting band clamp.
- c. Attach the second element, taking care to hold the element horizontal when applying clockwise torque. Rather than gripping the outer shell, apply torque by gripping the spokes on the upstream endcap with one hand, while supporting the element with the other hand. The ratcheting band clamp should be secured to prevent rotation.
- d. After the elements are snapped together, verify that the markings are properly aligned.
- e. By the time the third or fourth element has been installed, the ratcheting band clamp may be unnecessary. The band clamp is only required until friction generated by the installed elements is greater than the force required to snap the elements together.
- f. Push the elements deeper into the vessel. Repeat this process until all of the elements have been installed in the vessel. *Note: On iLECs* after connecting the last element, install the other *iLEC* adapter to the female end of the element.

Repeat these steps until all elements are loaded into the pressure vessels. The number of elements loaded into an individual vessel will depend on the length of the elements and the vessel itself. *Note: Do not push the elements in too far, if you do, then the end plate may not fit properly and the elements may have to be reinstalled.*

Element Loading (Cont.)

6. Install the downstream endcap assembly on each end of the pressure vessel:
 - a. Carefully position the downstream endcap assembly in the vessel and push the endcap assembly as a unit squarely into the end of the element. Use care when seating the O-ring seal on the adapter into the element and avoid pinching or rolling O-rings. *Note:* Make sure that the O-rings and product water tube are lubricated.
 - b. Rotate the endcap assembly to ensure proper alignment with the connecting piping.
 - c. Replace the hardware, sealing the endcap assembly in place. Refer to the pressure vessel manufacturer's drawing.
7. Push the element stack from the feed end (upstream) towards the downstream end.
8. After the elements have been installed, it may be necessary to add shims to reduce the amount of space between the face of the lead element and the face of the adapter hub. The vessel adapter internally connects the element product water tube with the permeate port on the pressure vessel. This procedure helps prevent movement and hammering of elements when the system starts and shuts down. Please refer to [Shimming Elements](#) (Form No. 45-D01057-en) for additional detail. Continue these steps for each pressure vessel in the train or system.
9. Install the feed endcap assembly on each of the pressure vessels like the downstream endcap assembly. Close each pressure vessel with the parts from the same vessel. Re-install any piping that was previously removed for element loading.

Excerpt from [FilmTec™ Reverse Osmosis Membranes Technical Manual](#) (Form No. 45-D01504-en), Chapter 4, "Loading of Pressure Vessels."

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Handling, Preservation, and Storage Storage and Shipping of New FilmTec™ Elements

General

FilmTec™ Membrane Elements should be handled in such a way that biogrowth and change in membrane performance during long-term storage, shipping or system shut-downs are prevented. The elements should preferably be stored and shipped outside the pressure vessels and loaded into the pressure vessels just prior to start-up.

Follow accepted safety practices when using biocide solutions as membrane preservations. Always wear eye protection. Consult the relevant Material Safety Data Sheets as supplied by the manufacturer of the chemicals.

Storage and Shipping of New FilmTec™ Elements

FilmTec™ Elements are tested and shipped either in dry condition or as wet and preserved elements. Wet elements are preserved in a standard storage solution containing a buffered 1 wt% food-grade sodium metabisulfite (SMBS). The storage solution prevents biological growth during storage and shipping of elements. For preservative Material Safety Data Sheets please visit the Answer Center at www.dupontwatersolutions.com.

Wet elements are bagged in a durable, oxygen-barrier composite plastic bag and preservative solution is delivered prior to vacuum sealing. Precise preservative volume and high bag integrity help ensure a stable preservative environment during transportation and storage.

Dry elements are bagged and sealed in a robust plastic bag. They do not require any preservation solution, but they should be kept in their sealed bag until they are used.

Please follow these guidelines for storage of FilmTec™ Elements:

- Store inside a cool building or warehouse and not in direct sunlight.
- Temperature limits: 25°F to 95°F (-4°C to +35°C).
 - New dry elements will not be affected by temperatures below 25°F (-4°C).
 - Elements stored in 1% SMBS will freeze below -4°C, but the membrane will not be damaged, provided the elements are thawed before loading and use.
- Keep new elements in their original packaging.

Storage and Shipping of New FilmTec™ Elements (Cont.)

- Preserved elements should be visually inspected for biological growth 12 months after shipment and thereafter every three months. If the preservation solution appears to be not clear the element should be removed from the bag, soaked in a fresh preservation solution and repacked. Refer to [Preservation and Storage](#) (Form No. 45-D01634-en) for guidelines. In case no equipment for re-preservation (fresh solution, clean environment, bag sealing device) is available, the elements can be left in their original packaging for up to 18 months. When the elements are then loaded into the pressure vessels, they should be cleaned with an alkaline cleaner before the plant is started up.

Preservation and Storage

Any FilmTec™ Element that has been used and removed from the pressure vessel for storage or shipping must be preserved in a preservation solution as follows:

- Use the standard storage solution of 1% food-grade SMBS (not cobalt-activated) in good-quality water (preferably reverse osmosis (RO) or nanofiltration (NF) permeate).
- Soak the element for 1 h in the solution; keep it in a vertical position so that the entrapped air can escape. Allow it to drip out, and seal it into an oxygen barrier plastic bag. We recommend reusing the original bag or original spare bags available from DuPont. Do not fill the plastic bag with the preservation solution—the moisture in the element is sufficient, and leaking bags might create a problem during transport.
- Identify the element and the preservation solution on the outside of the bag.
- The storage conditions are the same as for new elements – see [Storage and Shipping of New FilmTec™ Elements](#) (Form No. 45-D01633-en).
- Re-preserved elements should be visually inspected for biological growth every three months. If the preservation solution appears to be not clear the element should be re-preserved and repacked as above.
- The pH of the preservation solution must never drop below pH 3. In the absence of a buffer such as is used in the original preservative for wet FilmTec™ Elements, a pH decrease can occur when bisulfite is oxidized to sulfuric acid. Therefore, the pH of the bisulfite preservation solution should be spot checked at least every 3 months. Re-preservation is mandatory when the pH is 3 or lower.
- Wear protective gloves and sleeves to avoid prolonged contact with skin and sleeves when working with preservative.

Re-wetting of Dried Out Elements

Elements that have dried out after use may irreversibly lose water permeability. Re-wetting might be successful with one of the following methods:

- Soak in 50/50% ethanol/water or propanol/water for 15 minutes.
- Pressurize the element at 150 psi (10 bar) and close the permeate port for 30 minutes. Take care that the permeate port is reopened before the feed pressure is released. This procedure can be carried out while the elements are installed in a system. In this case, the pressure drop from the feed side to the concentrate side must not exceed 10 psi (0.7 bar) during high pressure operation with closed permeate port – otherwise the permeate backpressure near the concentrate end will become too high. Preferably, the permeate port is not completely closed but throttled to a value equal the concentrate pressure. Then there is no need for a special pressure drop limit.
- Soak the element in 1% HCl or 4% HNO₃ for 1 – 100 h. Immerse the element in a vertical position to allow the entrapped air to escape.

Shipping

Unless otherwise specified, when FilmTec™ Elements have to be shipped, they must be preserved with a preservation solution according to [Preservation and Storage](#) (Form No. 45-D01634-en).

Make sure that:

- The plastic bag does not leak.
- The element is properly identified.
- The preservation solution is correctly labelled.

We recommend using the original packaging with the original polystyrene foam cushions to protect the element from mechanical damage. Elements with non flush-cut product water tubes should be protected against damage to the product water tube ends.

The membrane elements will not be damaged by freezing temperatures during shipping provided the elements are thawed before loading and use.

Disposal

Used FilmTec™ Elements can be disposed of as municipal waste, provided:

- No preservation solution or other hazardous liquid is contained in the element.
- No depositions of hazardous substances are on the membranes (e.g., elements used in wastewater treatment).

Preservation of RO and NF Systems

The procedure of shutting down an RO/NF system has been described in Section 5.4. FilmTec™ Elements must be preserved any time the plant is shut down for more than a maximum of 48 h to prevent biological growth. Depending on the previous operational history of the plant, it will be necessary in almost all cases to clean the membranes prior to shut-down and preservation. This applies to cases when the membranes are known or assumed to be fouled.

After cleaning, the preservation should follow within the next 10 h as follows:

1. Totally immerse the elements in the pressure vessels in a solution of 1 – 1.5% SMBS, venting the air outside of the pressure vessels. Use the overflow technique: circulate the SMBS solution in such a way that the remaining air in the system is minimized after the recirculation is completed. After the pressure vessel is filled, the SMBS solution should be allowed to overflow through an opening located higher than the upper end of the highest pressure vessel being filled.
2. Separate the preservation solution from the air outside by closing all valves. Any contact with oxygen will oxidize the SMBS.
3. Check the pH once a week. When the pH becomes 3 or lower, change the preservation solution.
4. Change the preservation solution at least once a month.

During the shut-down period, the plant must be kept frost-free, and the temperature must not exceed 113°F (45°C). A low temperature is desirable.

Excerpt from [FilmTec™ Reverse Osmosis Membranes Technical Manual](#) (Form No. 45-D01504-en), Chapter 7, "Handling, Preservation and Storage."

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