



FILMTEC Membranes

Interconnector Technology

The interconnector between two membrane elements is a critical item in the overall performance of a reverse osmosis or nanofiltration system. The interconnector conducts the low pressure product water from element to element and ultimately out of a pressure vessel while keeping it separate from the high pressure feed and brine solutions. The interconnect must therefore be strong enough to withstand the pressure of the feed as well as provide a perfect seal between the feed and product water.

The new so called “dog bone” interconnectors address these needs and includes three features that give it advantages over previous generations of interconnectors. The new interconnectors replace both the 4 o-ring sea water interconnector and the 4 o-ring brackish water interconnector that was also used for nanofiltration elements.

Common Interconnector Design Features

All interconnectors, old or new, share some common design features. For instance, both old and new interconnectors are made of the same materials; Noryl or ABS for the interconnector body, and ethyl propyl rubber (EPR) for the o-ring. These materials have excellent resistance to the chemicals used in water service.

All interconnectors must be designed to withstand the feed pressure. The external pressure crush strength of the brackish water interconnector (black) was measured at greater than 2000 psig (135 bar). This is more than sufficient for all applications. The seawater interconnector (gray) has thicker walls than the brackish water interconnector and is even stronger.

All interconnectors must also be designed to minimize the bore side pressure drop. This keeps the permeate pressure to a minimum and maximizes the net driving pressure for the elements in a system. Net driving pressure directly determines the flow rate and rejection of a system. Minimizing the bore side pressure drop means that the inside diameter of the interconnector must be as large as possible without compromising the crush strength. The inside diameter of the new interconnectors matches the inside diameter of the old interconnectors traditionally used in each application.

A key parameter in the design of the o-ring seal is the dimensions of the o-ring groove. The o-ring groove has always been designed to maximize the squeeze of the o-ring seal. The squeeze of the seal is the percent ratio of the compressed height of the o-ring versus the cross sectional diameter of the o-ring in its relaxed state subtracted from 100. The squeeze of interconnector o-rings is ~25 to 30 percent. This is recommended for plastic to plastic seals.

O-rings are elastomeric, circular objects which provide a seal on interconnectors and adapters used in conjunction with FILMTEC® RO and NF elements. When functioning properly, this seal prevents the communication of feed water with permeate water thereby optimizing element salt rejection. There are a number of o-ring characteristics that are of importance in this application.

1. The durometer rating is a measure of hardness. The durometer rating on our o-ring is 70.
2. The squeeze is the cross sectional percent of compression of the o-ring between the groove and the other mating part. This number is not a property of the o-ring but rather determined by component design. Good design practice for a plastic to plastic seal is about 25 percent squeeze.
3. Volume swell is the change in the volume of a seal as a result of immersion in a fluid expressed as a percentage of the original volume. This is important in determining the acceptability of any new o-ring candidate.
4. The compression set is the percent of deflection by which the elastomer fails to recover after a fixed time under a specified squeeze and temperature. In this application, compression set causes flattening of the o-rings with time in service resulting in leaks.
5. The chemical composition and method of cure determines the chemical and physical properties of the o-ring. Our current o-ring is composed of ethylene propylene rubber (EPR) which has been peroxide cured. Peroxide cured o-rings as opposed to sulfur cured o-rings offer improved compression set.

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Special circumstances may warrant the use of alternate materials of construction for the o-ring. Some system owners have successfully substituted Viton or Teflon encapsulated o-rings. Viton o-rings are used when the feed water contains organic compounds which would swell the normal EPR o-rings. Teflon encapsulated o-rings should be considered when you need to avoid the use of a silicone or other lubricants on the interconnector seals.

FilmTec recommends that each time a pressure vessel is opened, that o-rings and seals be inspected. Any rolled or suspect looking o-rings and seals on the interconnectors, adaptors and vessel ends should be replaced. Note that on a typical pressure vessel, there are o-rings on the element inserted end of the adapter and inside the permeate port of the vessel end cap. Consult the vessel manufacturers instructions for the proper size of these o-rings and replace if necessary. Making sure that the seals and o-rings are lubricated, that proper shimming techniques are used, as well as inspecting and replacing all damaged o-rings is essential in proper system operation. Information on Vessel Shimming and Proper Lubrication is available from the FilmTec web site.

New Interconnector Advantages

The “dog bone” interconnectors offer three advantages over previous generations of interconnectors.

The first advantage of the new interconnector is that its total seal area is the same as the old 4 o-ring interconnector. It is the same because the o-rings used are twice the cross sectional diameter and the groove proportions are the same. Additionally, since the seal footprint is larger with one large o-ring, the likelihood of the seal bridging defects in the sealing surface is better. Having one large footprint seal is an advantage over two small footprint seals. Figure 1 is a scaled drawing of two smaller o-rings and one larger o-ring having twice the cross sectional diameter.

Figure 1a & 1b. O-ring Cross Section of Old and New Interconnector Ends

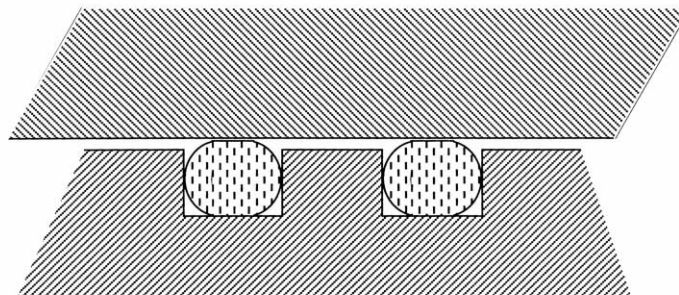


Figure 1a. Old Interconnector O-rings

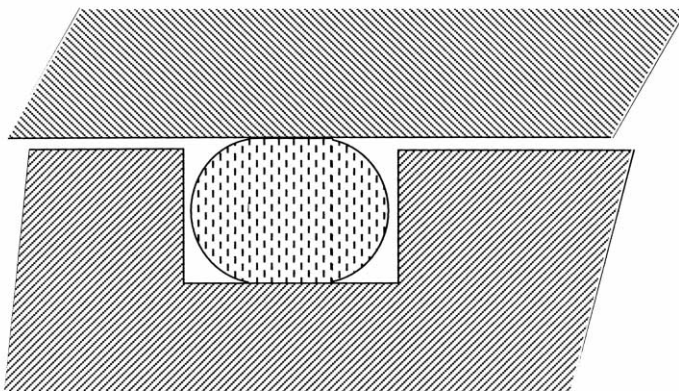
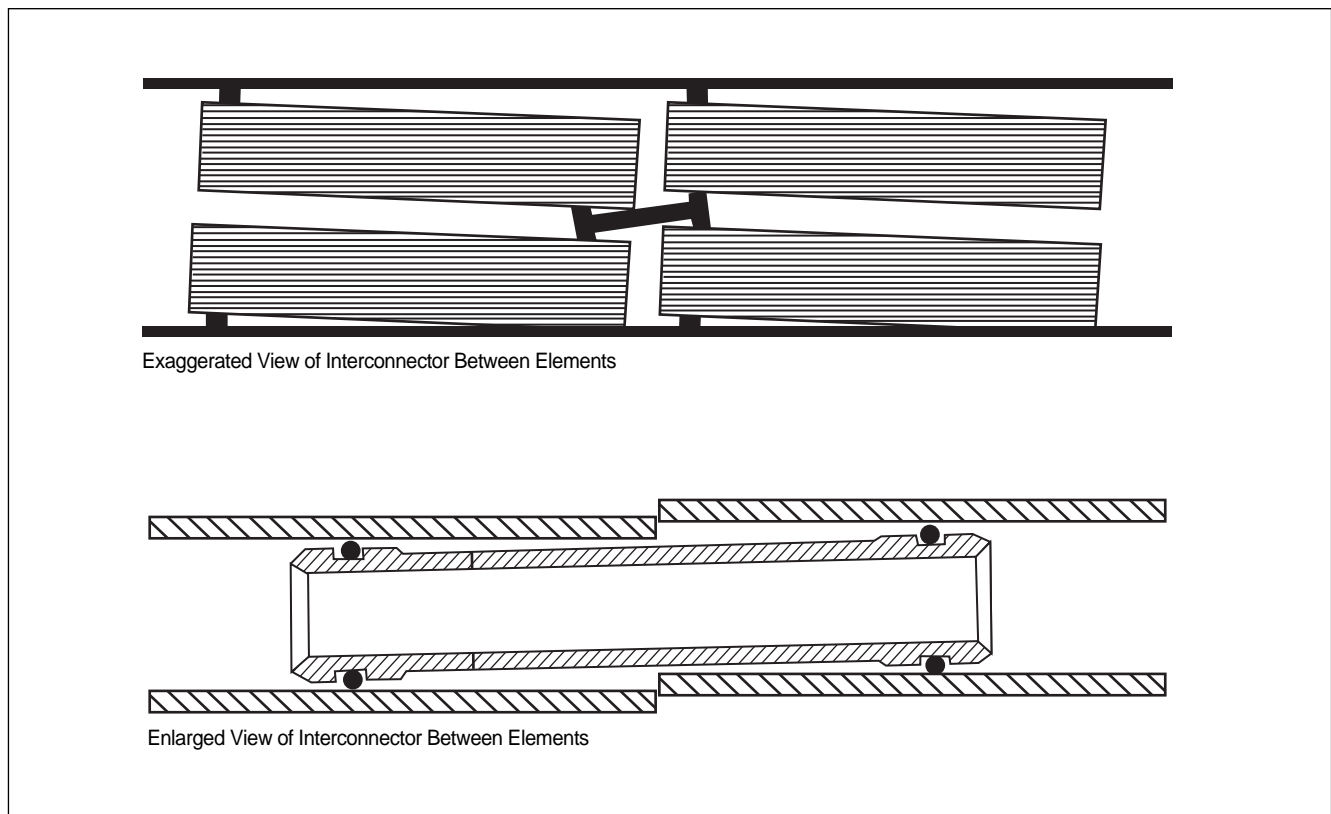


Figure 1b. New Interconnector O-ring

The second advantage of the new interconnector is that it allows for misalignment of the product water tubes of elements. Even though great effort is expended to make elements with the product water tube in the center, tolerances sufficient for sealing can not be maintained. Furthermore, the product water tube ends do not naturally line up because one end of the element has a brine seal while the other does not. The brine seal naturally centers one end of the element in the pressure vessel while the end without the brine seal, sags in relation. Figure 2 illustrates the potential misalignment of two elements and shows the enlargement of the interconnector alone. Since the interconnect has only one o-ring on each end and is narrow in the middle, it is free to pivot and correct for misalignment of product water tubes.

A third advantage of the new interconnector is that the larger cross section o-ring has less of a chance of “rolling out” of the o-ring groove. When o-ring sealed parts slides back and forth, the o-ring has a tendency to extrude into the gap between the two parts. In both the old and the new interconnector design, the gap between the parts is the same. But since the ratio of the o-ring diameter to the gap width is much larger for the new interconnector, there is much less chance of the o-ring coming out of the groove and the seal being damaged or lost.

Figure 2. Product Water Tube Misalignment







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For more information about FILMTEC membranes, call Dow Liquid Separations Business:
 North America1-800-447-4369
 Latin America(+55) 11-5188-9277
 Europe(+31) 20-691-6268
 Japan(+81) 3-5460-2100
 Australia(+61) 2-9776-3226
<http://www.dow.com/liquidseps>

Summary of Large Element Interconnectors

Table 1 summarizes the range of interconnectors used by FilmTec for 8" diameter elements. It shows both the part number of the interconnector and the part number and equivalence for the o-rings should they need replacement during system maintenance.

Table 1. FILMTEC Interconnector Summary

Interconnector	Interconnector Part Number	Replacement O-Rings
Brackish Water Interconnector 	FilmTec 103971 Used in all 8" BW30 & NF products except BW30LE-440 Injection Molded Noryl	FilmTec 89256 Parker 2-119 EPR
Sea Water Interconnector 	FilmTec 129768 Used in all 8" SW30 & SW30HR products Injection Molded Noryl	FilmTec 89256 Parker 2-119 EPR
Low Energy Interconnector 	FilmTec 103967 Used in BW30LE-440 Injection Molded ABS	FilmTec 102294 Parker 2-125 EPR
Full Fit Interconnector 	FilmTec 103968 Used in all 8" Full Fit & HS Products Polysulfone	FilmTec 89256 Parker 2-119 EPR

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Published June 2000.

