

## Technical Service Bulletin

Oct 2017 TSB122.07

### Element Loading Guidelines

This bulletin provides general information and guidelines for installing Hydranautics elements in order to provide optimally reliable performance.

### Storage of elements prior to loading

If the elements cannot be loaded upon delivery, be sure to store elements out of direct sunlight. Do not expose elements to temperatures below freezing, 32 °F (0 °C), or above 113 °F (45 °C). (Please refer to Hydranautics Technical Service Bulletin 108 for composite elements storage guidelines).

### Flushing

If the system is new, it is strongly recommended to flush the system (pipes, pumps, pressure vessels, etc.) with clean, fresh water prior to element loading. This allows any debris, preservatives, and solvents to be flushed out so that they do not come in contact with the membranes.

### Material, tools and equipment requirements

- Glycerin
- Pure silicone lubricant (Molykote 111 or Parker Super O-Lube)
- Permeate or fresh water
- PVC pipe or rope – length depends on the length of pressure vessels
- Sponge ball (to be fixed at one end of PVC pipe or rope)
- Towel or cotton rag
- 6" PVC Cap (when loading 8" pressure vessels)
- Shims (sizes of 1, 2, 2.5 and 5 mm thickness recommended)
- Brush or dauber for lubrication of brine seals
- Tools as per pressure vessel manufacturer recommendations for removing and installing of end cap assembly
- Spare parts for end caps (e.g. o-rings, lock rings, Victaulic clamps, nuts, bolts)
- Personal protection equipment (gloves, glasses, shoes, hard hat)

**Note:** When loading elements into a system, **do NOT use oil, grease, or petroleum based compounds** to lubricate o-rings and brine seals as these may cause damage to membrane or other components of the element. Use only silicone based gel or a mixture of 50% glycerin in water to lubricate o-rings and brine seals.

## Pressure Vessel Preparation

1. Remove pressure vessel end caps from both sides of the vessel (**Note:** Refer to pressure vessel manufacturer's manual for removal and re-installation of end caps assembly).
2. Disassemble and wash all end cap parts (i.e. o-rings, end adapters, etc.) in fresh water and keep them clean for re-installation. Perform an inspection and count all parts prior to reassembling to ensure integrity and inventory.
3. Clean the inside of the vessels to remove any dust and debris that could mechanically damage the membrane surface. Hosing down the insides of the pressure vessels with water usually **will not** be sufficient to clean the vessels.
4. Use a sponge ball wrapped in a towel or cotton rag and soaked in a 50-75% solution of glycerin and water. The sponge ball can be pushed/pulled through the vessel with a piece of rope or long PVC pipe. Alternatively, the sponge ball can be pushed through the length of the vessel with a piece of PVC pipe with a PVC flange attached to the end. The Glycerin solution will lubricate the inside surface of the pressure vessel to ease the loading of elements. Another method is to use a 6" PVC cap covered in rags (should fit snugly into the pressure vessel) attached to a rope slightly longer than the length of the vessel. Pull the 6" PVC cap covered in rags and soaked in glycerin through the vessel with the rope.
5. After cleaning the pressure vessel, re-install the brine side end cap assembly without covering side port openings with the thrust cone/sleeve. Before installation, lubricate end plate permeate adaptor O-rings and head seal with thin layer of pure silicone lubricant (Molykote 111 or Parker Super O-Lube).

**Note:** A 65/30/5% Glycerin/Water/SBS (sodium metabisulfite) solution can be used to help disinfect the vessels. Also, a 15:1 mixture of water and SBS (add about 1 cup of SBS powder to 1 gallon water) can be made to swab the vessels before the glycerin for disinfection, if necessary.

**Caution:** Be sure to avoid scraping the pipe along the vessel surface. Also, take care to push the end cap in squarely to avoid rolling the head seal.

## Loading of elements

1. Prior to loading, ensure all brine side end cap assemblies (including thrust cone/sleeve, head seal, end adapters, O-rings, etc.) are installed in the pressure vessels.
2. Maintain a loading record of each element serial number, vessel location, and position.
3. Open the element bag partially and expose the upper one-third of the element. This allows for the operator to have minimum exposure to the Fiberglass Reinforced Plastic (FRP) shell, while installing each element.
4. Gently slide the first element into feed side of the pressure vessel three-quarters of the way and remove the plastic bag. **Note:** Always load elements in feed flow direction with brine seal properly seated in seal groove of anti-telescoping device (ATD) and facing the flow direction. If the element uses a V-cup brine seal, ensure that the V-cup seal opens in the flow direction – Figure 1.

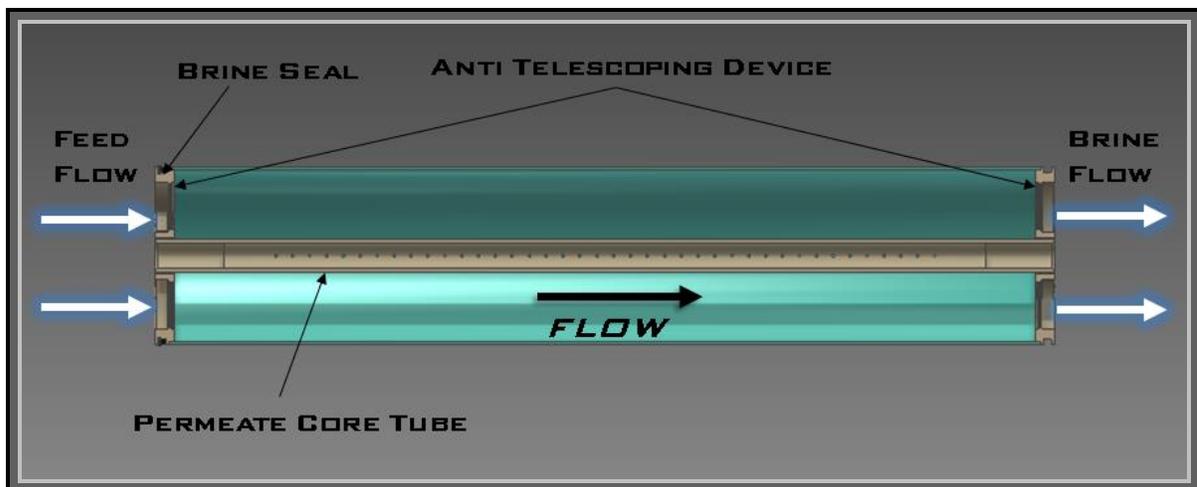


Figure 1 - Element Loading Direction

**Note:** The flow direction may not be the same for all vessels in a system.

**Caution:** Never put V-cup brine seals on both ends of an element.

**Caution:** RO elements are preserved with a solution containing 1% sodium bisulfite. Avoid direct contact with this solution.

5. Gently lubricate interconnector O-rings with thin layer of pure silicone lubricant (Molykote 111 or Parker Super O-Lube) and insert interconnector in permeate tube of first element.
6. Lubricate element brine seal with glycerin solution using brush or dauber.

7. Connect next element to interconnector and push both elements into pressure vessel up to three-quarters of the length of the element and again remove the plastic bag. **Caution:** Ensure the weight of the outboard element is not supported by the interconnector by supporting the element if necessary – Figure 2.

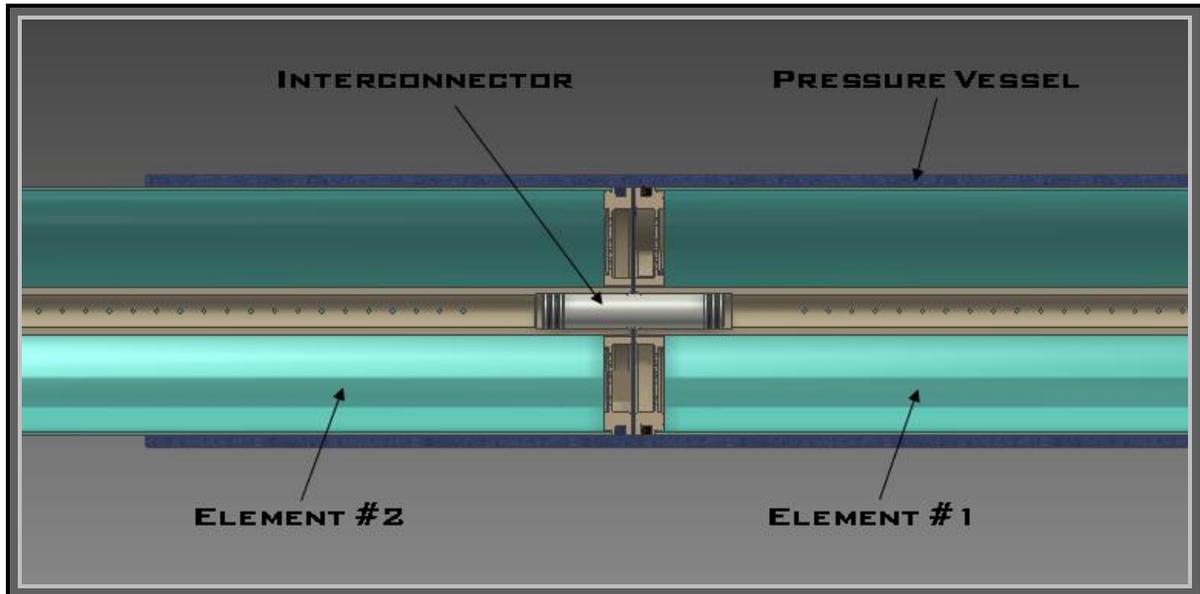


Figure 2 - Interconnector Configuration Between Two RO Elements

8. Repeat above steps with all other elements.
9. When installing last element, place hand on the face of the seal carrier and push the element stack completely inside the pressure vessel towards the brine end until the last element fully connects with end plate permeate adaptor on brine side of the pressure vessel. **Caution:** Watch fingers and hands for pinch points.
10. After loading all elements determine if shimming the vessel is necessary prior to installing the upstream end cap.

**Personal Safety Note:**

Element loading and unloading can require extended and repetitive physical motion. Simple stretching exercises before, during, and after loading/unloading multiple elements may help to reduce tightening and fatigue of joints and muscle groups used repeatedly during this type of work. So, if you begin to experience muscle tightness and/or joint fatigue, take a break and S-T-R-E-T-C-H. Use the following visual illustrations and instructions for proper stretching technique:

## HANDS

### Stretch Exercises

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#### Hand Stretch



- Extend your right arm out in front of you
- Turn your palm so your fingers point upward.
- With your left hand, gently pull fingers toward your body while locking your right elbow.
- Hold it for 5 seconds
- Repeat on the left hand.

## LEGS

### Stretch Exercises

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#### Thigh & Quad Stretch



- Start in a standing position. Raise your left leg behind you and grab your left foot.
- Keep your thighs parallel when performing this exercise.
- Don't arch your back.
- Hold for 5 seconds, then switch sides. (repeat 2 times).

## SHOULDER/BACK/NECK Stretch Exercises

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### Shoulder/Back/Neck Stretch



- With your right hand, pull your left shoulder across your chest as far as comfortable.
- Hold it for 10 seconds
- Switch arms and repeat.

## SIDES/ARMS Stretch Exercises

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### Side Stretch



- Reach up with both hands, elbows straight.
- Hold your right wrist with your left hand and pull upward.
- Lean to the left and push your hips to the right.
- Hold for 5 breaths.
- Reverse arms and stretch to the right.

## LEGS/BACK Stretch Exercises

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### Hamstring Stretch



- Stand with feet spread apart and knees slightly bent.
- Slowly bend from the waist and reach for the floor.
- Stay in this position for 5 breaths.
- Switch sides and repeat.

## SHOULDERS Stretch Exercises

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### Shrugs & Circles



- Shrugs: Pull your shoulders toward your ears.
- Hold for count of 5,
- Repeat 3 times.
- Circles: roll your shoulders forwards then backwards
- Repeat 3 times.

## Pressure Vessel Shimming

All pressure vessels are built with some tolerance in length to account for small differences in the length of the elements. Furthermore, the length of the pressure vessel also changes slightly due to expansion during operation. Therefore it is recommended to shim elements to take up free space in the vessel. This helps to prevent elements from moving when the system is shutting down and starting up. The appearance of leaks between elements is also minimized when the elements are shimmed and movement minimized. Insufficient shimming can lead to premature wear of interconnector and end plate adaptor O-rings or even to disconnections of elements from end plate adaptors. This will result in feed to permeate leaks and poor permeate quality.

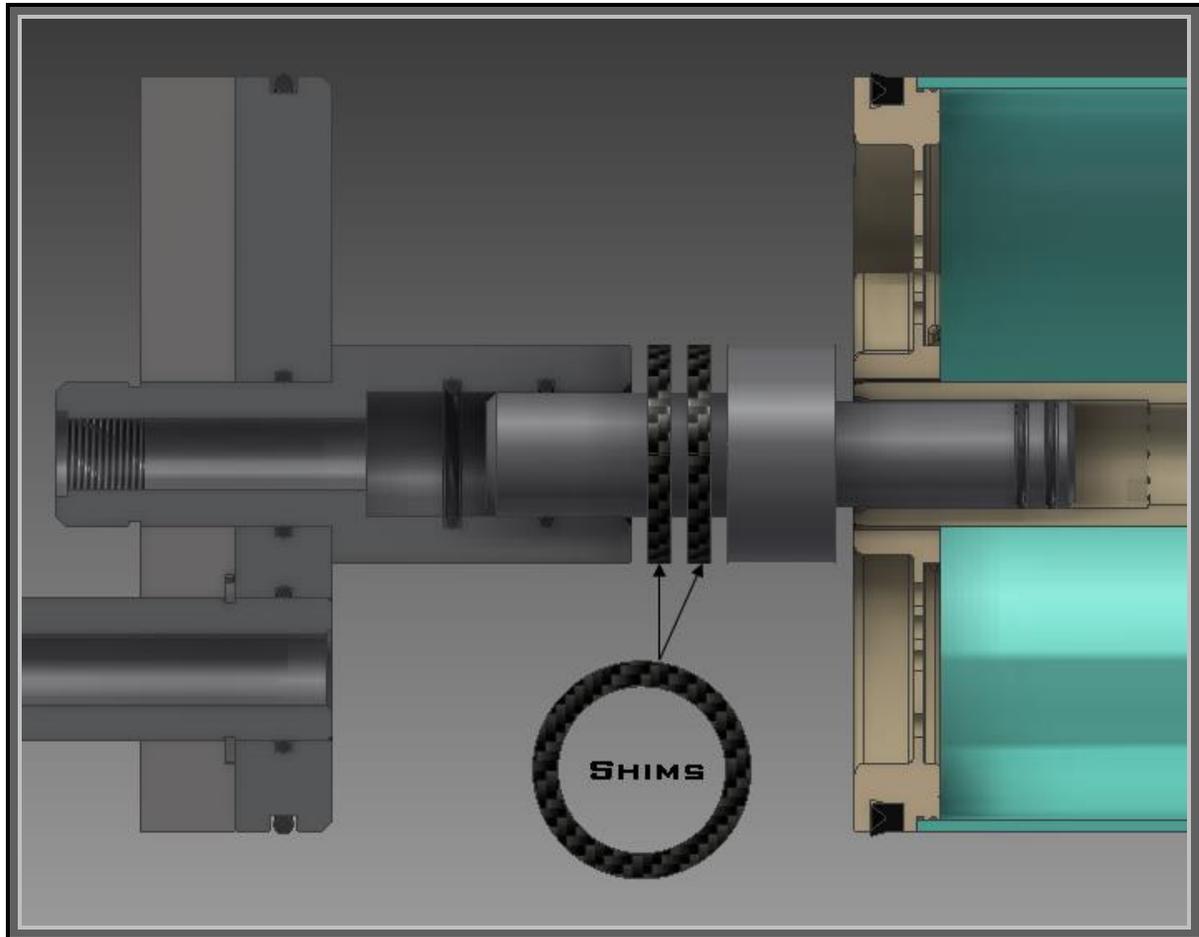
**Note: Always shim vessels from feed end side. Shimming from brine end side can lead to telescoping of the elements.**

The following procedure is recommended to shim the pressure vessel:

1. Remove O-rings from permeate adapter (element side) and head seal from feed end cap assembly.
2. Remove adapter from head assembly and gently lubricate adapter seal with silicone lubricant (Molykote 111 or Parker Super O-Lube).
3. Insert adapter into element permeate tube.
4. Gently slide end cap on adapter until bearing plate is in line with retaining ring groove on pressure vessel.
5. Gently remove end cap assembly from pressure vessel and measure the gap between adapter and permeate port (Figure 3).
6. Insert required quantity of shims over adaptor to completely fill the gap.
7. Insert adapter into end cap permeate port.
8. Install O-rings and lubricate them gently with pure silicone lubricant (Molykote 111 or Parker Super O-Lube).
9. Install head seal and lubricate it with glycerin.
10. Install end cap assembly.
11. Repeat above procedure on all pressure vessels.
12. Finally install end cap retaining device (segmented ring or spiral lock ring).

13. Re-install all connecting pipes.

**Note:** A gap of 2 mm between the end plate and the shims will not cause problems in performance.



**Figure 3 - Shimming**

14. Slowly fill the system with water at low pressure to prevent hydraulic shock (water hammer) at start-up. When all air is purged from the system, slowly bring the system up to design pressure and flow. Hydranautics recommends that the RO system be pressurized at no more than 10 psi (0.69 bar) per second to ensure no damage is done to the membrane element.
15. After operating for a few hours to a few days, stop the plant and inspect the end adaptor in section. It is possible that the membranes shift during initial operation. See figure 4 and 5 below.

Figure 4. End Adaptor –Correct Position

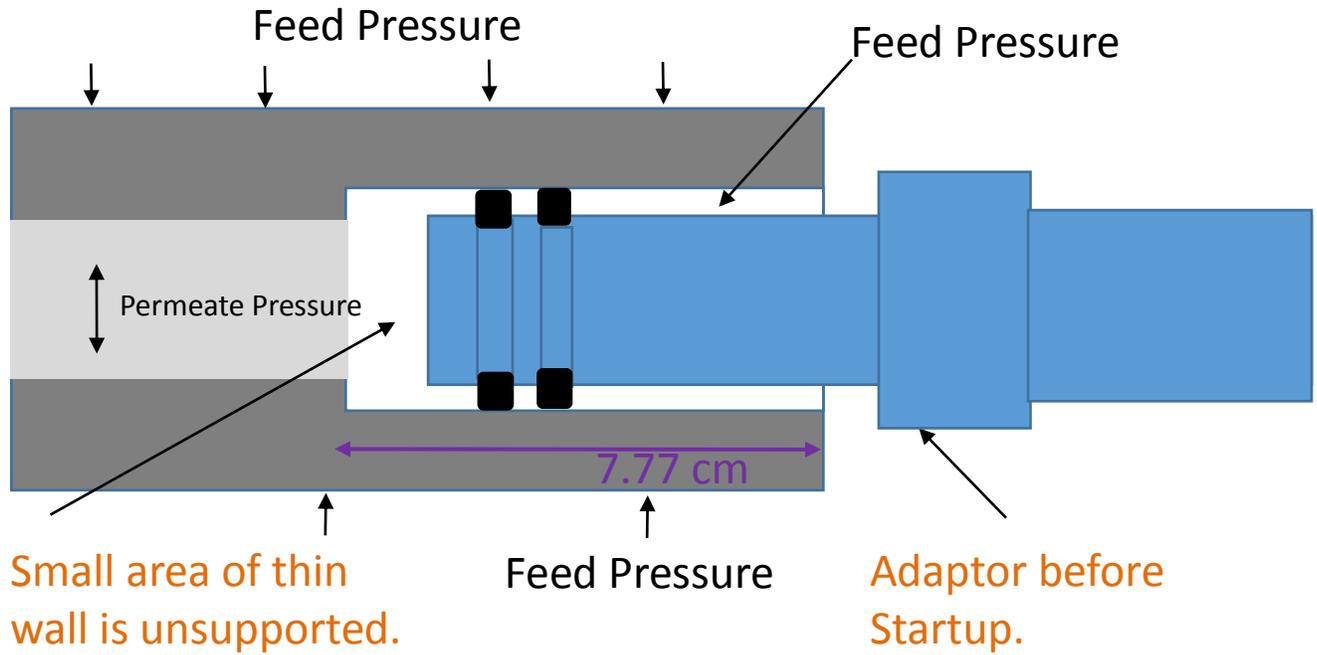
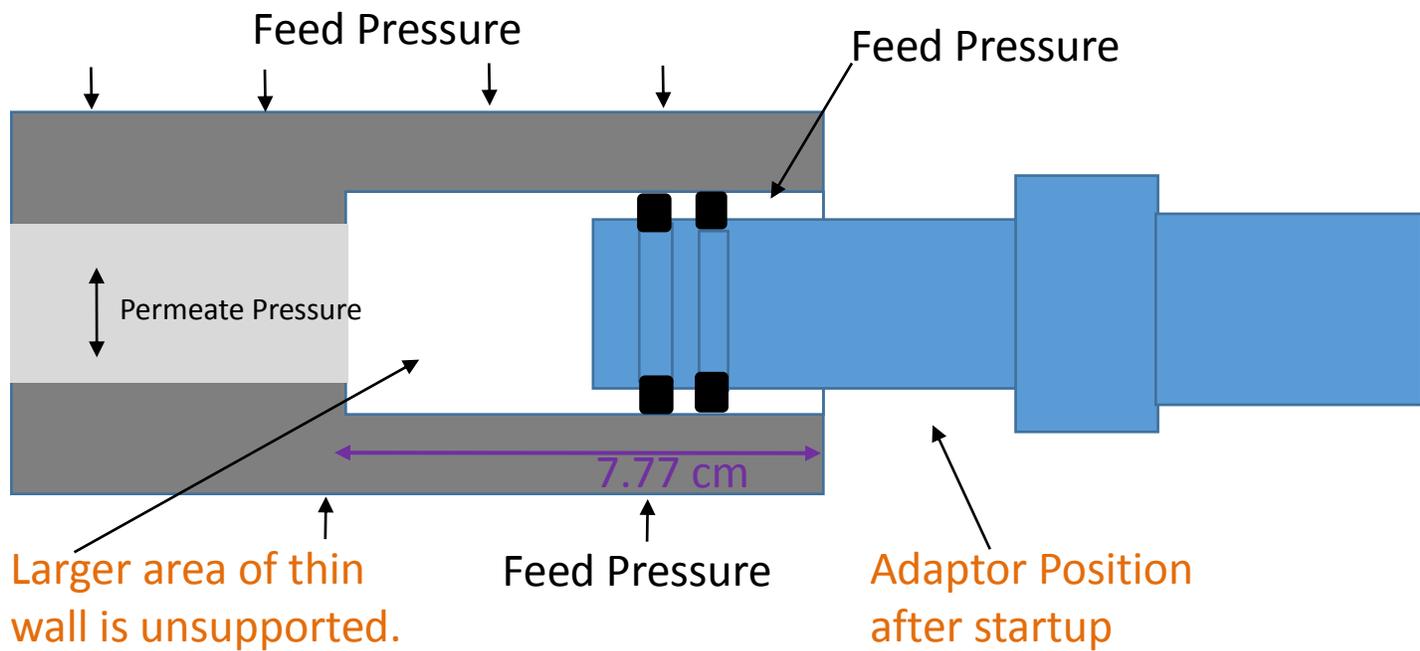


Figure 5. End Adaptor –Incorrect Position



## **Storage of new elements in pressure vessels**

Once the spiral elements are de-bagged and placed in the clean pressure vessel (PV) and shimmed, the PV should be closed and sealed from outside contamination. The elements will still have some SBS preservative in them, but this will be minimal and will not effectively prevent microbiological growth. Hydranautics thus highly recommends that the elements be flushed with in-spec feedwater, clean permeate or other comparable water within 30 days after de-bagging. Once the elements are flushed, further care should follow TSB118, TSB110 and TSB108 guidelines.

Hydranautics  
401 Jones Rd.  
Oceanside, CA 92058  
Tel: (760) 901-2500 Fax: (760) 901-2578  
e:mail: [info@hydranautics.com](mailto:info@hydranautics.com)  
Internet: [www.membranes.com](http://www.membranes.com)