

COMPOSITE VESSELS
FOR RO/NF/UF APPLICATIONS

Assembly and Operating
Instructions for
8 inch *AnyChem*[™]
Membrane Housings



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Intended Use

The vessel is designed in accordance with the standards of the American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section X.

It is designed for continuous long term use as a housing for spiral wound RO,UF or Nano filtration elements to desalt and purify typical brackish or seawater.

Fill the vessels 95% or more with incompressible media under **no** pressure.

Never fill it with compressible gases.

Any make of 8inch membranes can be easily fitted with our interfacing Adapters. For

Precautions

Dangerous! Our Pressure Vessels are designed to provide safe operation over a long service life if properly installed, operated, and maintained. This vessel may cause loss of life, severe bodily harm, or property damage if not correctly installed, operated, or maintained. Read and understand all guidelines given before attempting to open, service or operate this vessel.

Failure to follow these guidelines and observe every precaution may result in malfunction and could result in potential catastrophic failure. Misuse, incorrect assembly or use of damaged or corroded components can result in explosive release of the end closure. It is recommended that only qualified technicians experienced in servicing hydraulic systems work with this vessel.

Operation and Safety

Follow all instructions.

No warranty will be applicable if the vessels and the assembly parts have been subject to any accident, faulty installation and misapplication of the following Guide.

Mount shell

Support the vessel with horizontal members and saddles.

The span should be chosen as indicated in the vessel drawings.

Maximize the connection flexibility.

Position the vessel and the piping so that the vessel can grow in length and diameter under pressure without any undue restraint. We recommend an expansion loop in the branch.

Expansion will be app. * DIA = 0.7mm and * L = 6 to 8mm for a six element vessel.

Pressure and Temperature Design Limits

--Operation of a vessel outside its design limits will void the warranty and could result in vessel fatigue with possible eventual explosive head failure.

--**Attention!** The pressure rating for the permeate stream is limited and should not exceed 150PSI/10bars (unless certified differently)

--Do not pressurize vessel until end caps have been secured.

--Do not work on any component before verifying pressure is released from the vessel

--The pressure vessel should not be used as a support. Piping manifolds and other fittings should be supported by properly designed system framework. Operating personnel should be discouraged from applying undue force to any fittings connected directly to a pressure vessel.

Provide overpressure protection.

It is essential that over-pressure protection be provided such that the pressure to which any vessel is subjected cannot exceed 105% of design pressure.

Relieve system pressure before working on the vessel.

Do not work on any component under pressure! Check first that all pressure is released. Working on vessels that are under pressure may result in bodily harm and/or property damage.

Never support other components with the vessel.

Hang manifolds on ports or use the vessel as fixation for any item.may result in vessel damage.

The total weight of the branch connection should not exceed 6 kg on the feed/concentrate port and 4 kg on the permeate port.

The total external stress on the end plugs should not exceed 100N

Do not mount vessel directly on a rigid support.

Do not hard plumb either end of the vessel.

Do not over tighten the Permeate Port connection.

Tightening the connection more than one turn past hand tight will damage the port.

Double check end closure installation.

Ensure that retaining ring is in place and fully seated.

Never operate the vessel in excess of its ratings.

Do not operate vessel at pressures and temperatures beyond its rating. This practice will void the vessel warranty, shorten vessel life and could lead to bodily harm or property damage.

Flush the vessel

--Some feed waters may cause corrosion under static conditions. Flushing with non-corrosive permeate is recommended.

--After opening the housings flush the wetted surfaces with fresh water and prevent deposits.

--Before installing elements make sure that any kind of sand, improper ties.etc has been removed.

--Loosen deposits carefully with a brush or a sponge in time.

--Flush away loosened deposits with fresh water. The head assembly must be kept free of corrosion.

Do not install or store the vessel in direct sun light.

You risk uncontrolled local thermal expansion. (see “Guidelines for Installation...” at the end of the manual)

Please inform the factory when continuous operating temperature is less than 45°F.

Accessibility

Pressure vessels should be positioned within the system such that elements can be inserted at the upstream end and removed from the downstream end (i.e. elements are installed and removed in the direction of feed flow).

Compatibility

If the medium has different properties than water make sure that the medium does not affect the materials in contact. Check the medium compatibility also in regards of the pH level. Keep all interfacing parts -not in contact with the medium- dry and clean.

Do not allow salt and chemicals attack or corrode parts.

Catastrophic failure could result!

Inspect and maintain the vessel regularly and replace deteriorated parts.

| List of materials in contact with the medium: | |
|--|--------------------------------------|
| Liner | PVC |
| Endplates | PP |
| Seals | EPDM |
| Adapters | PVC |
| HP-Ports | 316L (BW) 254SMO/Superduplex (SW) |
| (these materials match the requirements of the EU for potable water) | |

Delivery

Make sure that delivery is complete and the label of the pressure vessel is matching with packing list and other documentation

Make sure that the vessels have not been damaged during transportation or handling.

Before installing a vessel in a system check the label on the vessel in order to be sure about the appropriate pressure rating.

Knappe Composites will assist the customer in determining the suitability of their specific operating conditions in regards of the use of our standard vessels. Do not hesitate to contact us.

The final determination for compatibility with the specific environment shall be the responsibility of the purchase.

Cleaning and Preservation

Make sure that the chemicals used comply in the used concentration with PVC/PP, SS and EPDM

WARNING! After any preservation you have to check the end plug system before pressurization of the vessel.

Examine at least one end plug from the inner side to confirm that no chemical attack occurred!

Trouble Shooting

Leakage at low or no pressure condition.

--With increasing pressure the leakage disappears.

Cause: Lip ring damaged.

Solution: Replace lip ring.

--Leakage persists with increasing pressure

Cause: May be due to dirty surface and / or damaged lip ring.

Solution: Examine for scratches in liner.

Clean the surface and the lip ring.

Check the lip ring.

Replace lip ring if necessary.

Small scratches can be eliminated by sanding carefully (grain 400 or more wet type)

--Leakage increases with pressure and then suddenly stops.

Cause: Lip ring installed in wrong direction.

Solution: Open pressure vessel.

Mount lip ring the other way round.

(V- Side faces middle of pressure vessel)

--Leakage increases with pressure.

Cause: Lack of lip ring.

Solution: Check whether lip ring installed.

If not, do install lip ring.

--At time of shutdown, limited leakage appears.

Cause: This may be due to drain of water and suction of air.

Solution: If this problem appears, please contact your supplier.

Installation Guide

Notes:

For installation of all rubber parts like Lip- or O-rings lubrication by glycerin is required.

---Do not use lubricating agents, which may contain petrol or are made on a petrol basis.

--- Do not use vegetable oil as well! Sponge or lint free cloth should be used for application of lubricant.

Do not work on any component under pressure!
Check first that all pressure is released.

Head Assembly

Step 1 Inspect All Head Components

All head components should be free from scratches, foreign matter, or any sign of damage. Examine each component for corrosion or damage that may affect the performance of the vessel. Replace any components that have corrosion or visual damage. In addition, carefully inspect each seal for damage or wear. It is recommended to replace each seal at this time. Please be aware that seal condition may affect system performance.

Step 2 Install the 8in Lip Ring onto the Sealing Plate

Install lip rings showing the opening (V) towards the inner side of the vessel. Make sure Lip Ring is completely seated on Sealing Plate.



Step 3 Install Feed/Concentrate O-rings - (FP-vessels)

All O-rings should be coated with a thin layer of Glycerine before installation.

Make sure that no chips, impurities or scratches are in the grooves.

O-rings must completely be seated in the grooves before further assembly.



Step 4 Install Permeate Port O-rings

One o-ring should be placed into the groove inside the port (for permeate port union). One o-ring should be placed in each of the two grooves on the outside diameter of the permeate port side(seals the PP-Port against the end-plate).



Step 5 Assemble High Pressure Port (FP-vessels)

Before assembling, the end of HP Port should be coated with a thin layer of Glycerine. Care should be used to minimize the amount of Glycerine applied and any excess should be removed.

Then place the HP port into the sealing plate



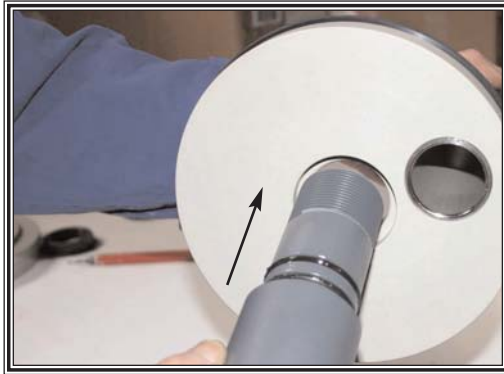
Step 6 Install the Retainer Ring for HP Port (FP-vessels)

Install the retainer ring into the groove in the machined end of HP port as a fixation. Make sure the retainer ring set remains firmly seated.



Step 7 Assemble Sealing plate and Permeate Port

Using extreme care, coat the O-Rings of the Permeate Port with a thin layer of glycerin. Push the permeate port down onto the sealing plate.



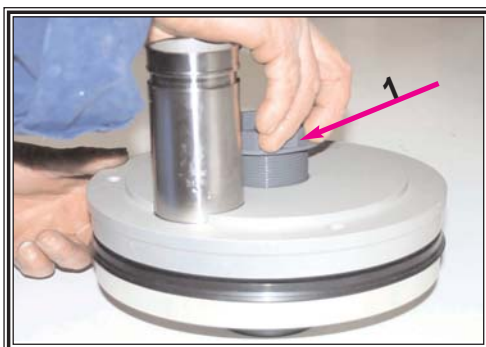
Step 8 Assemble the Front Plate for HP vessels (600-1200PSI)

Position the front plate (1) over the sealing plate, pushing them together so that the threaded portion of the permeate port is visible.



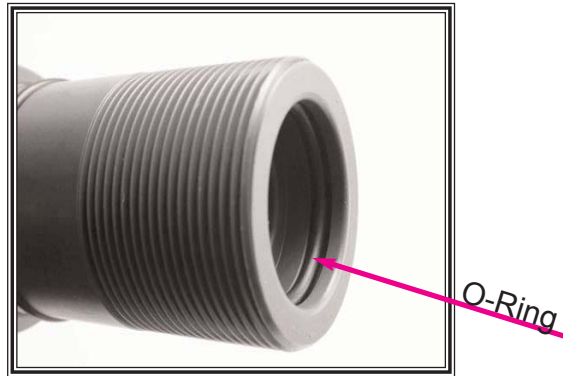
Step 9 Thread Lock Nut Onto Permeate Port

Lock nut (1) should be tightened until snug. Do not over tighten the Lock Nut.

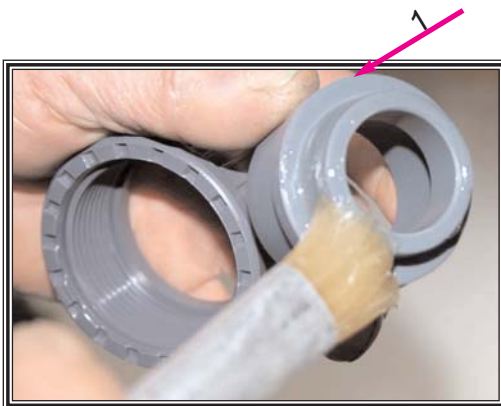


Step 10 Install Union Adapter (only for open permeate endplate)

Make sure that the O-Ring is properly installed in its groove and lubricated with a thin film of glycerine.



The adapter should be pushed into the permeate port until the wider diameter (1) middle section is flush against the end of the permeate port. Simultaneously pushing and turning (2) the adapter will ease installation. The adapter should be coated with a thin layer of Glycerine.



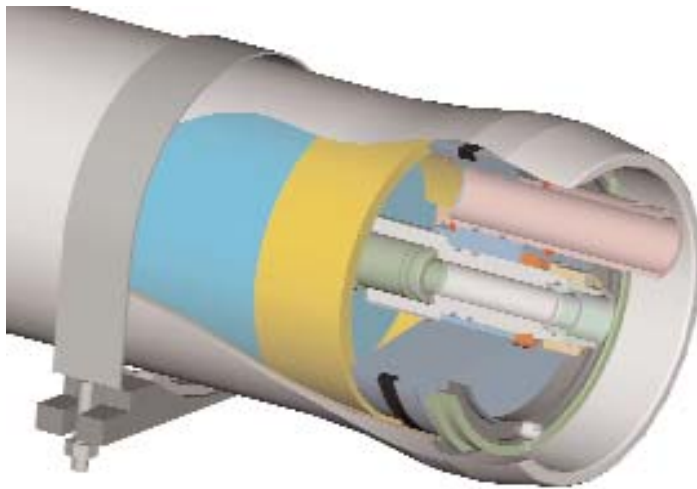
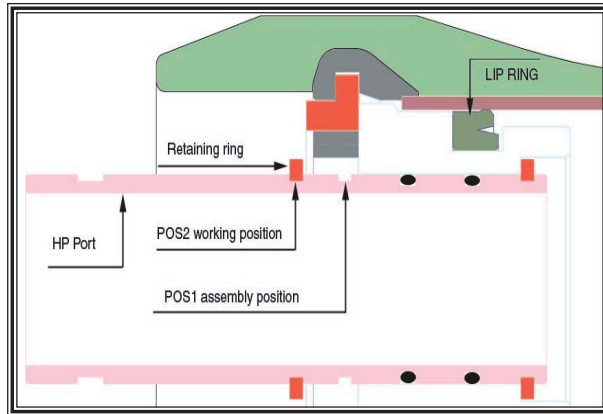
Installation of the HP Front port

Notes:

The HP Port has two positions for the retaining ring.

Pos 1 assembly position.

Pos 2 working position



The HP port compensates the elongation of the vessel in axial direction due to temperature and pressure.

To avoid stress on the end caps we designed our head assembly to allow free elongation of the vessel in axial direction.

The HP port may slide like a piston in the end cap.

To avoid inaccuracy when piping we recommend to assemble the end cap in the vessel with the retaining ring on the HP port in

Pos 1 (mounting position). After finishing the installation of your piping (before mounting the HP coupling on the ports) make sure that it fits well. Move the retaining ring to Pos 2 (working position).

You may eliminate the retaining ring because the port is blocked in forward motion by its solid shoulder in the end cap.

·Before assembling the end cap system into the vessel make sure that the end caps are in the position in Fig 1

Step 1 Inspection

Inspect the vessel in side surface for any corrosion deposits or other foreign matter. Before installing the endplates with the Lip-rings please make sure that the pressure vessels have been cleaned and are completely free from dirt and small particles. Small deposits and tiny scratches can be smoothed with 400 grain wet type emery paper. Rinse away all loosened deposits from the shell inside surface.

Step 2 Lubrication

Make sure entire head seal is covered with a thin layer of Glycerine Lubricant (non petrol based), with no dirt or dust contamination.



Step 3 Install Head

Make sure the lip-ring covered with a thin layer of Glycerine Lubricant (non petrol based). Hold the head assembly with both hands, square to the axis of the vessel. Push firmly with both hands until the head is correctly positioned and the retaining groove is visible.



Step 4 Install Locking Segments

Clean and dry the retaining groove. Position the three locking segments so that the end section sits in the retaining groove.



Step 5 Install Locking Ring

Position the locking ring as shown and tighten the screw by hand until snug. Do not over-tighten. Conduct a final tightness check of each screw after all three segments are installed.



Step 6 Pressurize System

A thorough pre-pressurization inspection should be conducted, including verifying that the heads are properly installed, system piping connections are in place, elements are installed, adapters are installed, and thrust cone is installed at downstream end of the vessel. Retighten the screw again until you do not have leaks anymore.

Head Removal

Step 1 Shut Down System

Shut down system and take all steps necessary to relieve system pressure from the vessel.

Step 2 Disconnect Permeate Piping

Carefully disconnect the permeate piping from the permeate port. Set this piping in a secure place for re-assembly.

Step 3 Check End Closure

Examine the end closure for any corrosion or damage. Remove any corrosion with a brush and flush away the deposits with clean water. Order replacement components as required.

Step 4 Disconnect Locking Screws

Each of the three locking segments is held in place with a locking ring. The locking ring is held in place with 3 locking screws. The locking screws can be unthreaded using a hex wrench. You need to fasten them only hand tight.

Attention!

Remove the Lip-ring only by hand. Do not use any tools.

The use of screwdrivers, knives or similar tools risk damaging the surface of the end plug and/or the Lip-ring and may lead to leakages.



use low torque

Installation of elements in the vessel

- You install the elements from the 'Feed' side.
- Insert the spacer into the pressure vessel.
You will push it with the elements towards the 'Brine' side.
It needs to be located on the down streamside of the vessel.
- Insert the open adapter (68ADxx) in/on the first membrane.
- Install then all elements by interconnecting and pushing them gradually into the vessel.
- Push this package (68ADxx), spacer (68SPACE/xx) and the membranes until the 'Brine' endplate blocks the move.
Before that happens the element adapter (68ADxx) will penetrate into the permeate port body of the endplate.
Be careful not to smash it in. The spacer has now contact with the endplate and the elements and the groove of the groove-ring on the 'Feed' side is completely visible.
- Install the closed adapter (68ADxx/C) 9.2 in/on the last membrane. ('Feed' side)
- Now you want to install the 'Feed' endplate assembly (18STxx/F) and regulate the distance between the element plug (p.2) and the regulator plug (9.5)
- Measure the distance [A] in fig1 ,the surface of the permeate port body closed (9.3) and the endplate.
- Reduce the distance between the regulator plug (68REG PLUG) 9.5 and the Permeate port body (9.3) to its minimum. (Fig1)
- Place the endplate without the lip-ring (58LIP) into the pressure vessel. and install the segmented rings.
- Loosen the nut (68SCR15Z) 10.2 from the permeate port body (68PP/BC2) 9.3.
- Push the Permeate body (9.3) into the 'Feed' endplate until it blocks against 9.2 (Fig2)

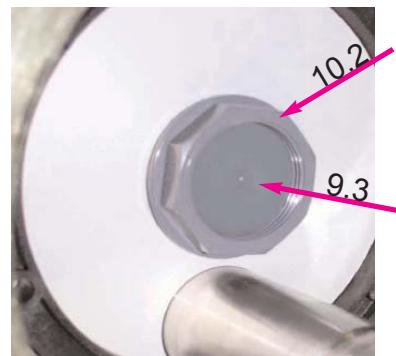
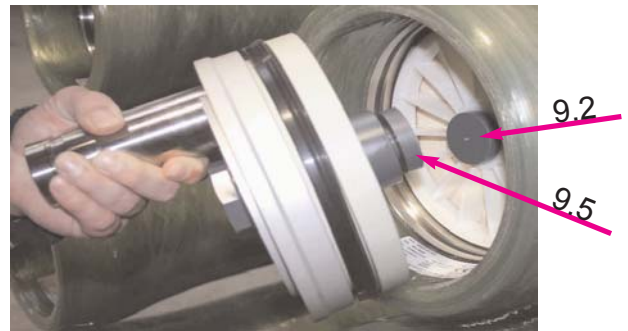
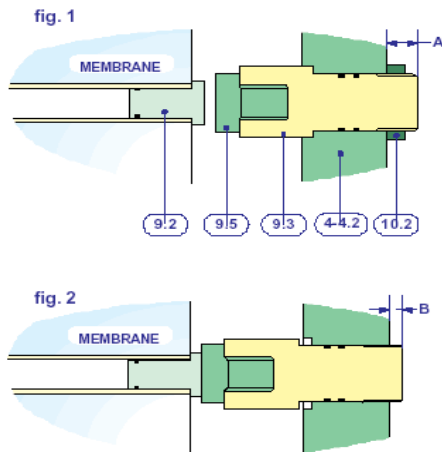
- Measure distance [B]
- Remove feed endplate (18STxxx/F) and tighten Nut 10.2
- Calculate the difference $[A]-[B]=[D]$
- Add a gap between the element plug and the regulator plug for thermal expansion of the elements

Call that gap=[G]

Example: you use 6elements and 1mm extension/element $[G]=6*1\text{mm}=6\text{mm}$)

- The distance between the regulator plug 9.5 and the permeate port body 9.3 shall be [R]
 $[R]=[D]-[R]$ or $[R]=[A]-[B]-[G]$

- Install the feed endplate (18STOV2/F) with the lip-ring (58LIP) into the pressure vessel after you have regulated the distance [R]



If any of the endplate items are not installed properly, the closure of the pressure vessel is not safe and can cause severe damage.

Info: The membrane inter-connectors are provided by the membrane supplier. Further questions please find in your guideline of installation of elements.

Elasticity and Mounting Recommendation

Mounting design must allow the vessel grow freely both axially and radially. Although the expansion under pressure is slight, undue restriction can result in damage to the vessel and to other system components. Expansion will be app. * DIA = 0.7mm and * L = 6 to 8mm for a six element vessel.

--We recommend an expansion loop in the branch.

--Support the vessel with horizontal members and saddles. Do not mount directly to any rigid structure.



--The span should be chosen as indicated in the vessel drawings.

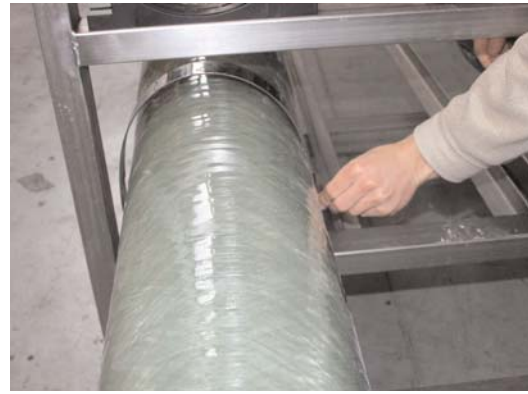
--Manifold span should be greater than vessel span to allow for vessel growth under pressure.

--In our design, there are holes for fixation of the saddles on the frame. They are elliptical in order to have the flexibility for alignment.



The support strips (1) are exchangeable and made out of an elastomer. The strips are available in two thicknesses in order to have similar distances between the centerline of the vessel and the frame

(thick strip:21..31bar vessels; thin strip:42..84bar vessels)



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The

Header and related piping should be self-supported. **Do not use the ports of the vessel to support them.**

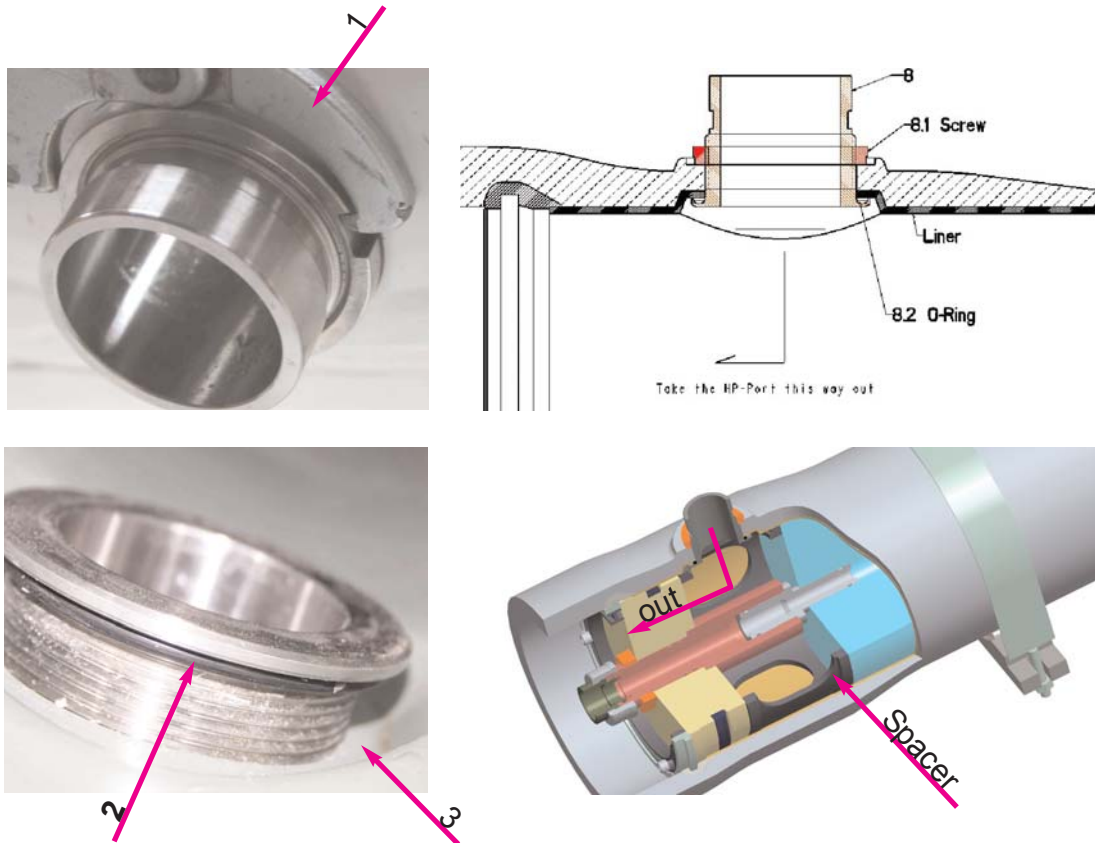
--Use the stainless steel straps furnished. Straps should be tightened sufficiently to hold the vessel on the support saddles, but not so tightly as to restrict expansion or deform the vessel body.

Changing the O-ring of the HIGH PRESSURE Side Port-Only applicable on Side port vessels

Open the endplates in order to access to the HP-Port (Pos.8)

Use an appropriate size spanner wrench (1) and unlock the screw (Pos.8.1)

Take the HP-Port out from the vessel inside.



Change the O-Ring (2) and lubricate it with glycerine

Clean the liner at the contact surface (3). Make sure that no chips, imperfections remains and put the HP-Port back in.

Tighten the screw. Avoid that the port turns while tightening.

Pressurize the vessel.

Retighten the screw again until you do not have leaks anymore.

Before assembling the end cap system into the vessel make sure that the end caps have clean and lubricated lip rings mounted.

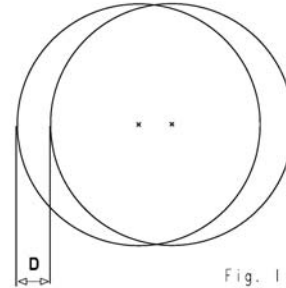
Use only glycerine.

Make also sure that the liner does not have deposits and is clean.

Guidelines for Installation of Side port vessels

Fig.1 shall represent an axial misalignment between two pipes to be connected with a Victaulic style clamp.

D is the axial misalignment of two pipes face to face. This misalignment **D** should not be larger than 0.03inch / 0.76mm in any direction. If you exceed this value you might loose warranty and destroy parts. (see also technical requirements from the coupling manufacturers)



- dimensional tolerances and D

By connecting several vessels on the same header you might run (due to tol.) into the problem having two different vessels with a difference of length in between the ports of +/- 2.54mm or 5.2mm as total.

The vessels would still be in their manufacturers dimensional tolerances.

D would become 2.54mm for each port if you center the vessel exceeding the maximum of 0.76mm by 3.

-pressure and D

-The expansion due to pressure for a six-element vessel (L="6500mm) ranges in between 2-2.5mm and exceeds up to 1,67 times the maximum allowed value of 0,76mm.

-temperature and D

-The expansion due to temperature at $\Delta T=20K$ is 2,34mm

$$(\Delta L = a * 6500mm * 20K = 2,34mm)$$

The thermal elongation coefficient (a) is " $18 * 10^{-6}$ K-1.

A pressure vessel working in between 10°C and 30°C will change its length by 2,34mm

-force deployed by temperature

The young's module (E) is approximately 32000N/mm²

Design Data for a 1000PSI vessel:

- outer shell diam. (Da) = 234mm
- inner shell diam. (Di) = 208mm

The force due to this thermal elongation will be $F = \Delta L / L * E * p / 4(Da^2 - Di^2)$

$$F = 2,34 / 6500 * 32000 * 3,14 / 4(234^2 - 208^2) = 103977N \text{ or } 104KN$$

Add the force created by the pressure and **you will find a total load of > 122KN !!!**

**IT IS NOT GOOD PRACTICE TO HARD PLUMB THE HP PORTS TO THE COLLECTORS
ALLOW EXPANSION OR YOU RISK DAMAGE !!**