

USER'S GUIDE

E8 Series

Fiberglass Pressure Vessels For Reverse Osmosis

MODEL E8U
ULTRAFILTRATION

250
PSI

MODEL E8L
LOW PRESSURE RO

400
PSI

MODEL E8B
BRACKISH RO

600
PSI

MODEL E8S
SEAWATER RO

1000
PSI

MODEL E8H
SEAWATER RO

1200
PSI

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CodeLineTM

PRESSURE VESSELS

By



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FOREWARD

The E8 Series Family of Vessels

The E8 Series is a standardized family of fiberglass pressure vessels designed for continuous, long-term use as housings for reverse osmosis membrane elements. Any make of eight-inch nominal diameter spiral-wound element is easily accommodated.

The E8 Series includes four models having different pressure ratings. They are unified in design and have a maximum number of parts in common. Each model has the appropriate strength and materials of construction to provide years of continuous use in typical service when properly maintained.

The Model E8U Ultrafiltration Pressure Vessel is designed for use in RO/UF membrane softening at pressures up to 250 psi. The Model E8L Low Pressure RO Pressure Vessel is designed for use in reverse osmosis at pressures up to 400 psi. The Model E8B Brackish RO Pressure Vessel is designed for brackish water desalting at pressures up to 600 psi. The Model E8S Seawater RO Pressure Vessel operates at pressures up to 1000 psi for seawater desalination. The Model E8H Seawater RO Pressure Vessel operates at pressures up to 1200 psi for seawater desalination.

Each model is available in lengths to house from one to seven 40-inch long elements and two, four or five 60-inch long elements.

The E8 Series is designed and built in accordance with the engineering standards of the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers (ASME Code). A vessel marked with an ASME Code stamp is accepted worldwide as being built to the highest standards of safety.

Each model in the E8 Series has passed rigorous ASME Code qualification tests which require that vessels not burst at less than six times their design pressure. Safe use is further assured in that vessels will not fail catastrophically; overpressure is relieved by weeping through the fiberglass shell. Also, every production vessel is tested to one and one-half times its design pressure to verify structural integrity.

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Note: Due to difference in design of the E8 port retainers, some pages in this guide apply either to the E8U or the E8L/E8B/E8S/E8H models only. Pages are headed accordingly. Pages not so headed apply to all E8 models.

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E8 SERIES USER'S GUIDE

MODEL E8U

ULTRAFILTRATION

250
PSI

MODEL E8L

LOW PRESSURE RO

400
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MODEL E8B

BRACKISH RO

600
PSI

MODEL E8S

SEAWATER RO

1000
PSI

MODEL E8H

SEAWATER RO

1200
PSI

Danger - High Pressure Device

This vessel may cause loss of life, severe bodily harm, and/or property damage if not correctly installed, operated and maintained. Read and understand all guidelines given before attempting to open, operate or service this vessel.

Failure to follow these guidelines and observe every precaution may result in malfunction and could result in catastrophic failure.

Misuse, incorrect assembly or use of damaged or corroded components can result in high-velocity release of the end closure.

We recommend that only a qualified mechanic, experienced in servicing high-pressure hydraulic systems, open, close and service this vessel.

This section is a guide to proper operation and maintenance of Advanced Structures E8 Series pressure vessels. Good industrial practice must be used in applying this information to assure safe vessel use. These guidelines are not intended to relieve the user from full responsibility for correct operation and maintenance of the vessels.

For information on application and installation, refer to the E8 Series **Application and Installation** sections.

For technical specifications and dimensions, refer to the Engineering Drawing of each specific model.

The information in all three sections must be carefully adhered to in order for the vessels to provide the safe, long service life for which it is designed.

OPERATION AND MAINTENANCE GUIDE

Proper vessel handling and installation are important to safe use and long vessel life. The guidelines outlined herein should be followed carefully; however, they are intended only as guidelines and do not relieve the purchaser from full responsibility for proper inspection, handling and installation. Damage due to improper handling or installation is the sole responsibility of the purchaser.

Improper assembly, misuse or corrosion damage can result in mechanical failure, property damage and serious injury or death. ***Read and follow all instructions carefully.*** Pay particular attention to the safety precautions given in this **Operation and Maintenance** section. Should any information in this guide not agree with the system supplier's instructions, call Advanced Structures, Inc. for clarification.

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SAFETY PRECAUTIONS

DO

- Read, understand and follow every part of this section. Failure to take every precaution may void warranty and could result in catastrophic failure.
- Install in an area where water leakage resulting from a vessel or piping malfunction would not damage sensitive or expensive equipment, such as electronic components.
- Verify that head locking components are properly placed and secured.
- Inspect end closures regularly, replace deteriorated components and correct causes of corrosion.
- Follow membrane element manufacturer's recommendations for loading elements into vessel (see **Replacing Elements** on page OM-9).

DO NOT

- Operate vessel at pressures in excess of specific rating or temperatures over 120°F. (See vessel information chart on page OM-3.)
- Service any component until you verify that vessel pressure is fully relieved from the vessel.
- Use corroded components. Use of such components may result in catastrophic failure.
- Pressurize vessel until after visually inspecting to insure that all interlock components (locking ring set, securing ring and securing screws) are correctly installed and secured.
- Tolerate leaks or allow end closures to be routinely wetted in any way.
- Use excessive silicone lubricant.

INSTALLATION NOTES

Even though your vessel may have been installed by others, there are a few quick checks on installation you should make before use.

Vessels must be installed correctly to ensure safe use and long service life.



Vessel mounted with drain holes down on horizontal support frame using compliant black urethane saddles; hold-down straps tightened just snug.



Vessel free to expand under pressure; shell not clamped rigidly in place; piping to vessel ports not made with rigid connections.



Vessel not used in any way to support other components, such as piping manifolds hanging from ports.

If you have any questions about the installation of the vessel in your unit, contact your supplier. For installation guidelines, refer to the **E8 Series Installation Guide**.

VESSEL INFORMATION CHART

	MODEL E8U	MODEL E8L	MODEL E8B	MODEL E8S	MODEL E8H
MAX. OPERATING PRESSURE (PSI)	250	400	600	1000	1200
OPERATING TEMPERATURE RANGE	20°F. to 120°F.				
FACTORY TEST PRESSURE (PSI)	375	600	900	1500	1800
PROTOTYPE MIN. BURST PRESSURE (PSI)	1500	2400	3600	6000	7200
ENGINEERING DRAWING NUMBER	507007	507003	507002	507001	507028
E8 SERIES USER'S GUIDE	507011				

PRE-PRESSURIZATION CHECKLIST

Danger — High Pressure Device

This vessel may cause loss of life, severe bodily harm, and/or property damage if not correctly installed operated and maintained. Read and understand all guidelines given before attempting to open, operate or service this vessel.

Failure to follow these guidelines and observe every precaution may result in malfunction and could

result in catastrophic failure.

Misuse, incorrect assembly or use of damaged or corroded components can result in high-velocity release of the end closure.

We recommend that only a qualified mechanic experienced in servicing high-pressure hydraulic systems, open, close and service this vessel.

This checklist is an operational aid intended to augment detailed guidelines given in the E8 Series **Operation and Maintenance Guide**.

Note that the checklist alone does not include all the details needed for safe vessel operation. Use the checklist each time any service operation is carried out to ensure that each step is completed before pressurizing the vessel.

MEMBRANE ELEMENTS

- Installed per manufacturer's recommendations.
- Feed flow direction correctly noted and elements correctly oriented.
- Column of elements centered inside shell.

ELEMENT INTERFACE

- Adapters installed at both ends of element column.
- Thrust ring installed downstream from element column.

HEAD

- All components in as-new condition, clean and free of damage or corrosion.
- All components properly assembled with new, freshly lubricated seals.
- Port retainer for feed/concentrate port in correct position.
- Port nut snug – E8L/B/S/H (Note: left-hand thread)
- Permeate port snap ring installed – E8U

HEAD ASSEMBLY INTERLOCK

- Locking groove at each end of shell clean, free of corrosion and/or delamination with outboard face of groove true and in sound condition.
- All components in as-new condition, clean and free of damage or corrosion.
- All three segments of the locking ring set fully seated and held in place by the securing ring and screws.

PIPING CONNECTIONS

- Properly secured.
- Leak free.

Assembled By: _____

Date of Assembly: _____

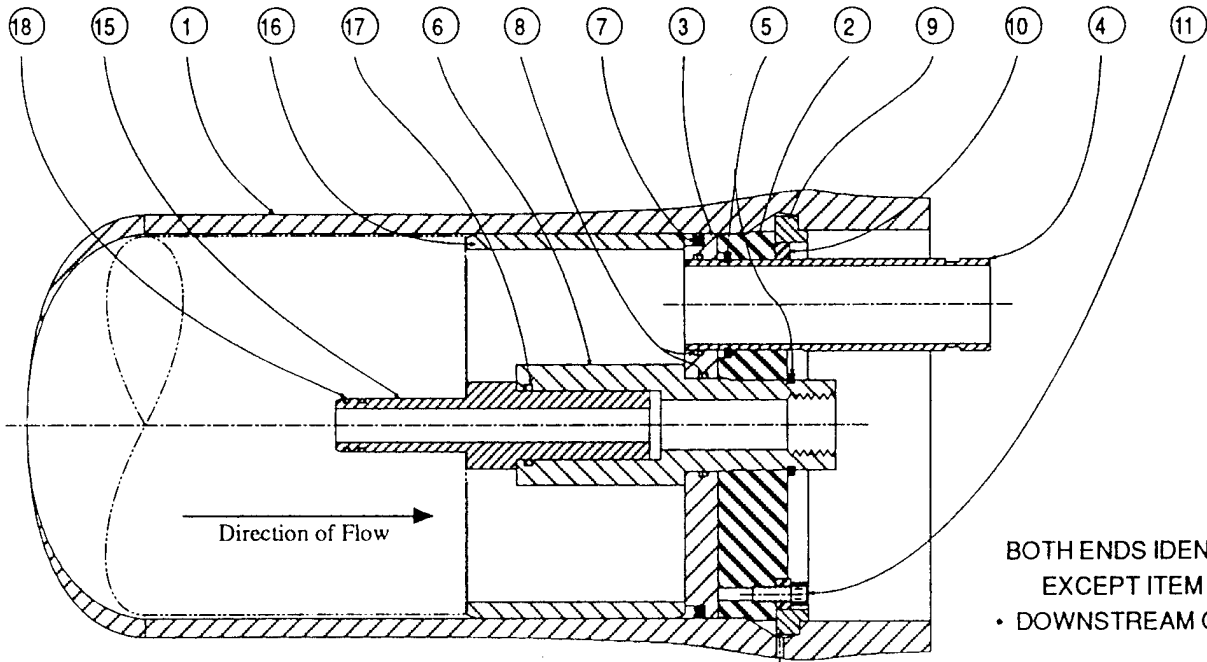
Checked By: _____

Date of Inspection: _____

The following vessels listed by serial number below were serviced under this checklist:

COMPONENT IDENTIFICATION

• E8U ONLY •

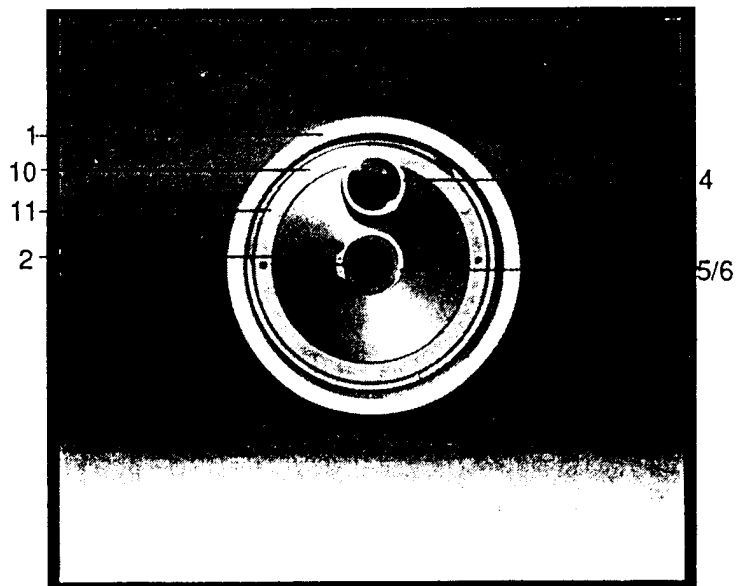


BOTH ENDS IDENTICAL
EXCEPT ITEM 16
• DOWNSTREAM ONLY •

SECTION THROUGH END CLOSURE

Dwg. Ref.	Qty. Per	Part Name	Materials/Remarks
SHELL			
①	1	Shell	Filament wound epoxy/glass composite — Head locking grooves integrally wound in-place
HEAD			
②	2	Bearing Plate	6061-T6 aluminum alloy — hard anodized
③	2	Sealing Plate	PVC thermoplastic
④	2	Feed/Concentrate Port	Type 316 stainless steel
⑤	4	Port Retainer	Type 304 stainless steel
⑥	2	Permeate Port	PVC thermoplastic
⑦	2	Head Seal	Ethylene propylene rubber — Quad ring
⑧	4	Port Seal	Ethylene propylene rubber — O-ring
HEAD INTERLOCK			
⑨	2	Locking Ring Set	6061-T6 aluminum alloy — hard anodized — three distinct pieces per set
⑩	2	Securing Ring	Reinforced plastic — color yellow
⑪	6	Securing Screw	316 SS 5/16-18 UNC x .75 lg. HSHCS
ELEMENT INTERFACE			
⑮	2	Adapter	Engineering thermoplastic
⑯	1	Thrust Ring	PVC thermoplastic — install downstream
⑰	2	Adapter Seal	Ethylene propylene rubber — O-ring
⑱	4	PWT Seal	Ethylene propylene rubber — O-ring
FOR REFERENCE ONLY			

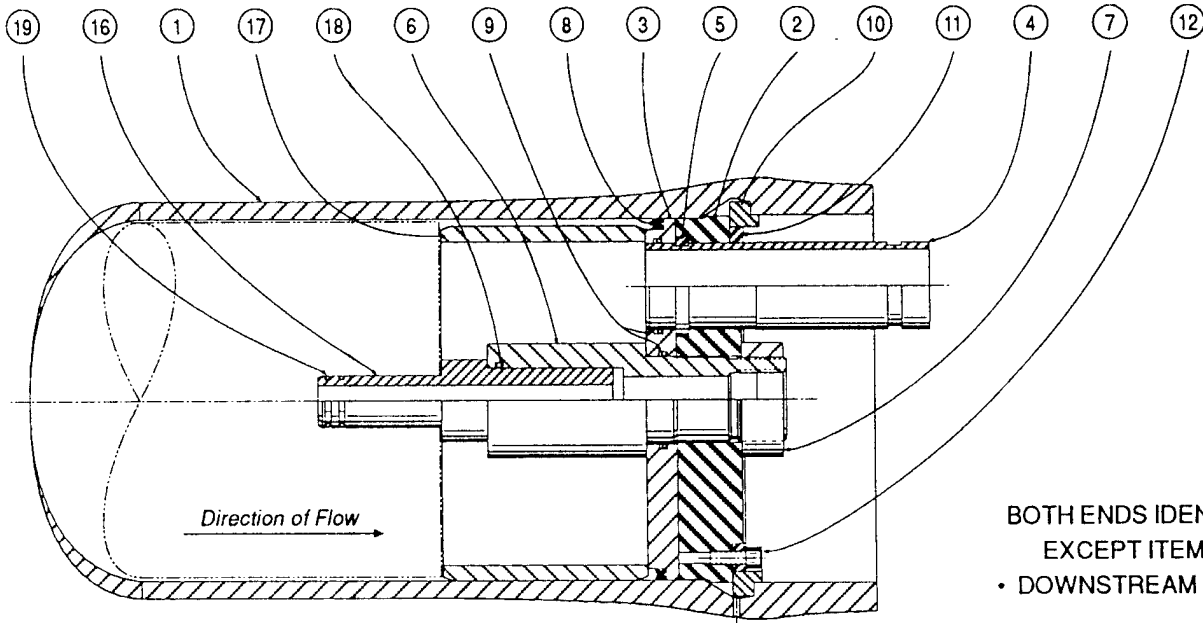
NOTE: Reference Numbers 12,13, and 14 refer to vessel support items not relevant here and are not shown.



End closure component identification

COMPONENT IDENTIFICATION

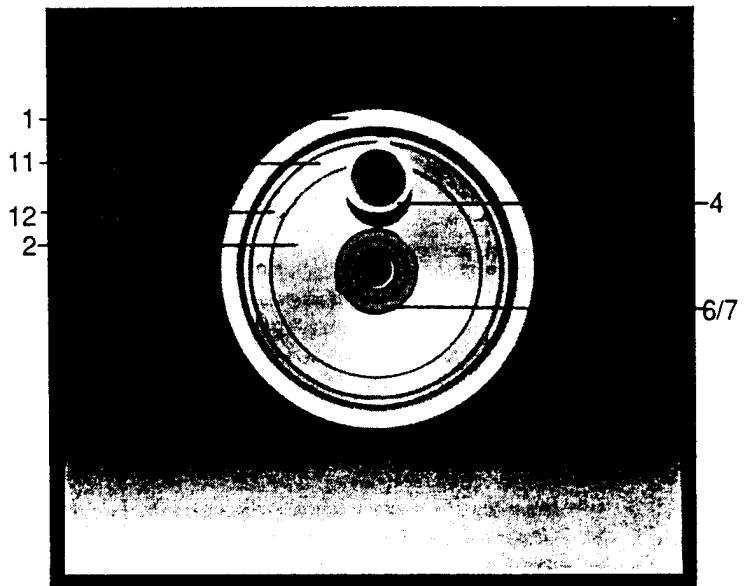
• E8L/B/S/H ONLY •



BOTH ENDS IDENTICAL
EXCEPT ITEM 17
• DOWNSTREAM ONLY •

SECTION THROUGH END CLOSURE

Dwg. Ref.	Qty. Per	Part Name	Materials/Remarks
SHELL			
①	1	Shell	Filament wound epoxy/glass composite with integrally wound in-place head locking grooves
HEAD			
②	2	Bearing Plate	6061-T6 aluminum alloy — hard anodized
③	2	Sealing Plate	PVC thermoplastic
④	2	Feed/Concentrate Port	Type 316 stainless steel
⑤	2	Port Retainer Set	Type 304 stainless steel — two identical pieces per set
⑥	2	Permeate Port	PVC thermoplastic
⑦	2	Port Nut	PVC thermoplastic — left hand thread
⑧	2	Head Seal	Ethylene propylene rubber — Quad ring
⑨	4	Port Seal	Ethylene propylene rubber — O-ring
HEAD INTERLOCK			
⑩	2	Locking Ring Set	6061-T6 aluminum alloy — hard anodized — three distinct pieces per set
⑪	2	Securing Ring	Reinforced plastic — color yellow
⑫	6	Securing Screw	316 SS 5/16-18 UNC HSHCS
ELEMENT INTERFACE			
⑬	2	Adapter	Engineering thermoplastic
⑭	1	Thrust Ring	PVC thermoplastic — install downstream
⑮	2	Adapter Seal	Ethylene propylene rubber — O-ring
⑯	4	PWT Seal	Ethylene propylene rubber — O-ring
FOR REFERENCE ONLY			



End closure component identification

NOTE: Reference Numbers 13,14, and 15 refer to vessel support items not relevant to this guide.

OPENING VESSEL

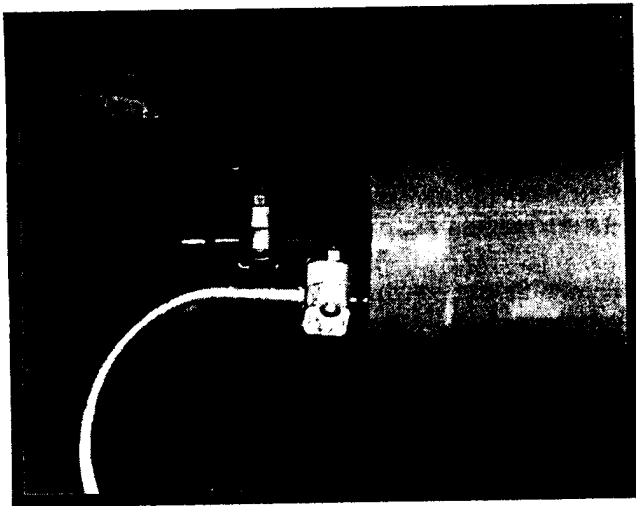
Step-By-Step Guide

NOTE

Read all guidelines in this section before attempting to open the vessel.

WARNING

DO NOT ATTEMPT TO SERVICE ANY COMPONENT WITHOUT FIRST VERIFYING THAT PRESSURE IS FULLY RELIEVED FROM THE VESSEL.



Disconnecting Ports

STEP 1 RELIEVE PRESSURE

1. Shut off all sources of pressure and relieve pressure from the vessel, following the system manufacturer's recommendations.

WARNING

ATTEMPTING TO REMOVE ANY COMPONENT BEFORE PRESSURE IS RELIEVED MAY RESULT IN EXPLOSIVE RELEASE OF HEAD.

STEP 2 DISCONNECT PORTS

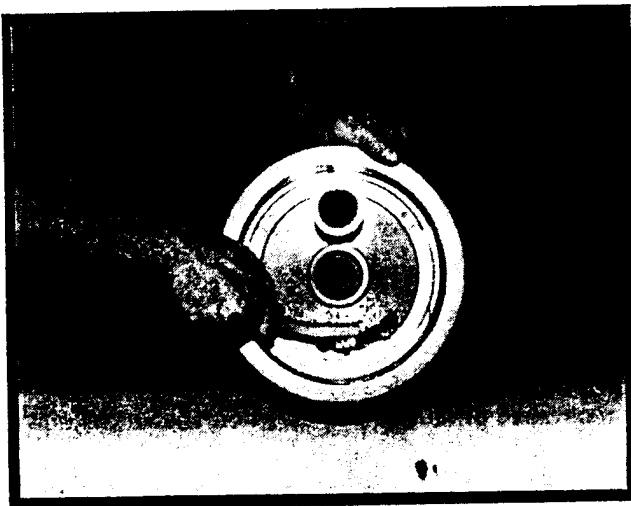
1. Disconnect vessel ports from piping manifolds.

STEP 3 EXAMINE END CLOSURE

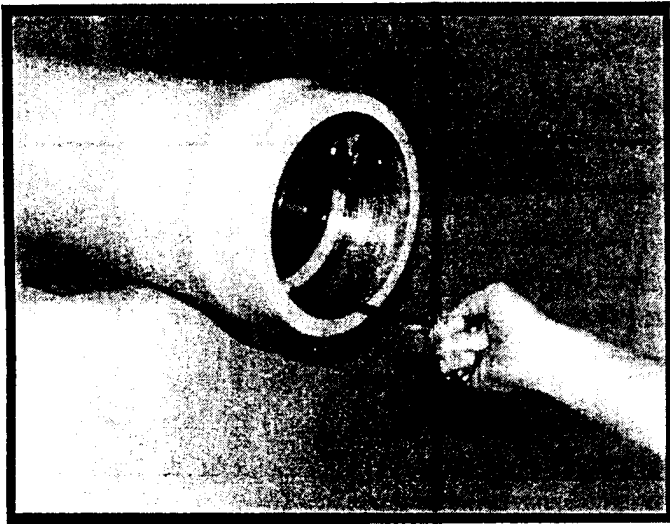
1. Examine end closure of vessel for corrosion. If any is evident, proceed as follows:
 - A. Loosen any deposits with a small wire brush and/or a medium grade piece of Scotchbrite™.
 - B. Flush away loosened deposits with clean water.

CAUTION

Corroded products can cause difficulty in removing head and/or other components. Do not attempt to remove components until all apparent corrosion is removed.



Loosening Deposits



Securing screw removal

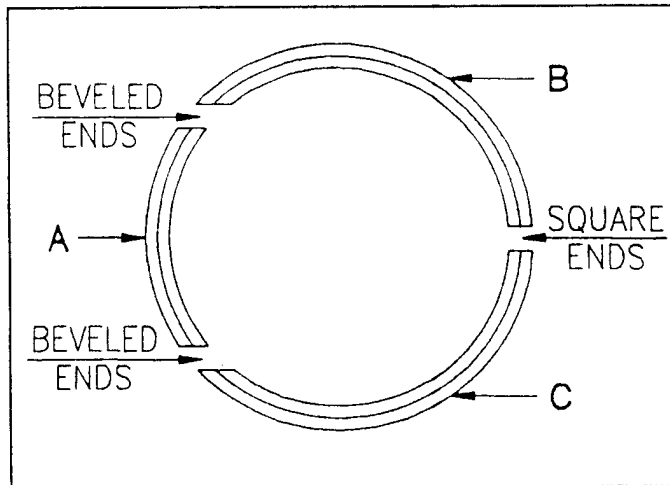
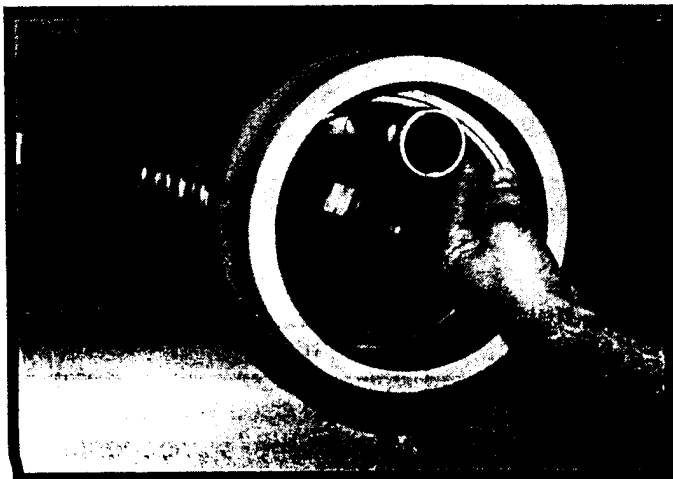


Figure 1



Key segment removal

NOTE

For maximum ease of head removal, joints should be broken as near to vessel as possible. To facilitate alignment upon reassembly, make an index mark on the shell to indicate original position of feed/concentrate port.

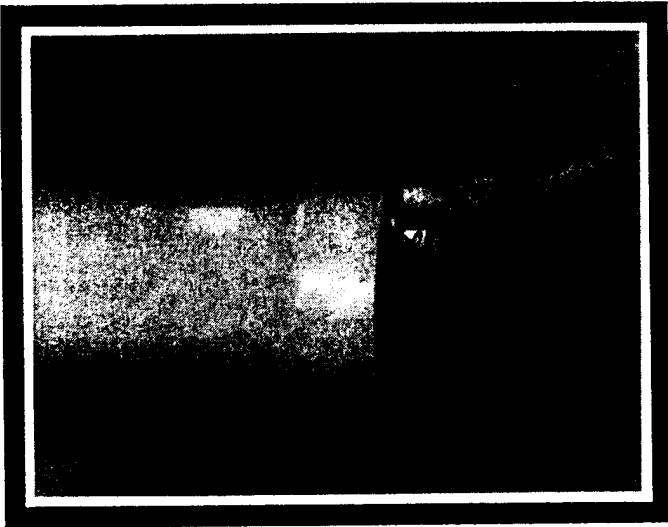
STEP 4 REMOVE INTERLOCK

1. Use a 1/4" hex key wrench to remove the three securing screws from the yellow plastic securing ring. Place one of the screws aside for use on reassembly. Thread the other two screws into the threaded jacking holes in the securing ring until they contact the bearing plate. If excessive corrosion build-up prevents threading, refer to **Troubleshooting**.

NOTE

Some securing rings have three threaded holes. In this case, thread all three screws into the securing ring.

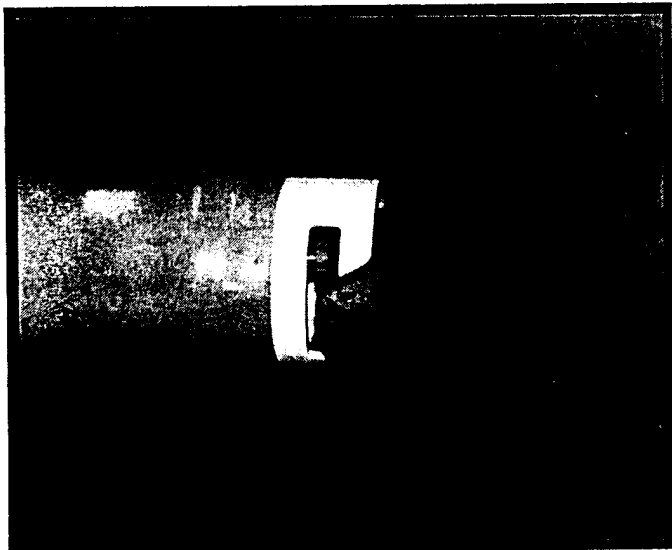
2. Grip the two (2) screws firmly and pull the securing ring towards you. Once ring is free, carefully remove it from the bearing plate.
3. If ring cannot be freed by this method, then use the screws as jacking screws by turning 1/4 turn on each screw. If this does not move securing ring relative to bearing plate, **DO NOT** continue to turn screws. Refer to **Troubleshooting**.
4. Once ring has started to move, repeat procedure in 2. above.
5. Use a cushioned mallet or hammer in conjunction with a wood block to tap bearing plate face. This should free locking ring segments.
6. Refer to **Figure 1** for locking ring segment identification.
7. Rotate locking ring set so that segment **A** (key segment) is at the 12 o'clock position. Segment **A** can now be removed. If segments will not rotate, refer to **Troubleshooting**.
8. Repeat step 6 for segments **B** & **C**.
9. After removal of segments, remove all debris (corrosion products, dirt, etc.) from the vessel end.



Head assembly removal — by hand

NOTE

It may be helpful to rock head slightly to break head seal bond.



Head assembly removal — using head tool

STEP 5 REMOVE HEAD

CAUTION

Do not strike or apply undue force on ports to remove heads.

NOTE

If vessel has been in service for some time, head may be difficult to remove. For assistance in head removal, E8 Series head tool (p/n 107028-1) is available from Advanced Structures, Inc.

STEP 5A REMOVAL BY HAND

1. Grasp feed/concentrate port and pull head straight out. A sharp forceful tug may be required to start head assembly moving.
2. If the head seal remains in the vessel bore, it should be removed at this time.

STEP 5B REMOVAL USING HEAD TOOL

1. Insert the tool into the shell with threaded rods in line with holes in bearing plate.
2. Thread the rods into the bearing plate holes and turn until the knobs bottom out.
3. Grasp tool with both hands and pull straight out to remove the head. If the head will not release from the shell, refer to **Troubleshooting**.
4. To remove the tool from head, reinstall head part-way into the shell so that the tool is compressed, then unscrew rods.
5. If the head seal remains in vessel bore, it should be removed at this time.

REPLACING ELEMENTS

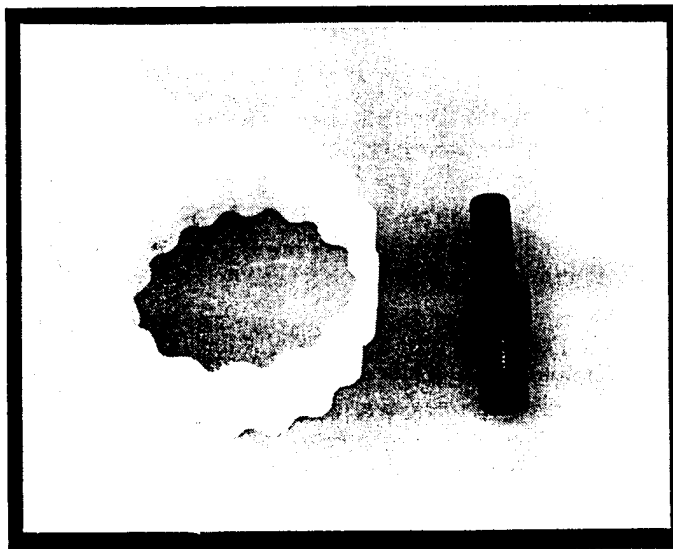
NOTE

Read all parts of this section before replacing elements. These procedures are provided for general information only. Elements should be installed in accordance with the element manufacturer's recommendations.

WARNING

DO NOT ATTEMPT TO SERVICE ANY COMPONENT WITHOUT FIRST VERIFYING THAT PRESSURE IS FULLY RELIEVED FROM VESSEL.

MAKE SURE THAT THE CENTRAL (PERMEATE) TUBE OF MEMBRANE ELEMENT STACK IS CONNECTED TO THE PERMEATE PORTS INSIDE BOTH ENDS OF VESSEL, USING THE ADAPTERS SUPPLIED. PRESSURIZING VESSEL WITHOUT ELEMENTS AND BOTH ADAPTERS INSTALLED COULD RESULT IN CATASTROPHIC FAILURE.



Thrust Ring

Adapter

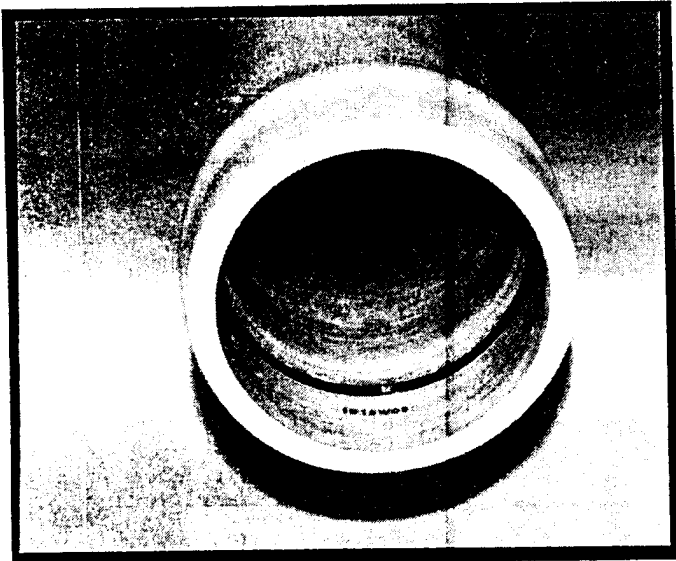
PRELIMINARY STEPS

DO NOT PROCEED WITH STEP BY STEP INSTRUCTIONS UNTIL...

1. All pressure has been relieved from the vessel, following system manufacturer's recommendations.
2. Both heads have been removed from vessel following step by step instructions in **Opening Vessel**.

STEP 1 REMOVE ELEMENT INTERFACE HARDWARE

1. Remove thrust ring from downstream end.
2. Remove adapters from elements at each end.



Examine bore for scratches

NOTE

- Always remove and install elements in the direction of feed flow. The feed end (upstream end) is the end plumbed most directly to the pump.
- Seal lubricant must be applied sparingly. Excess lubricant may foul the element.
- Flooding the vessel with clean water or 50/50 glycerine/water mixture will ease element assembly.
- A record of element serial numbers and locations should be made and checked during loading.

STEP 2 ELEMENT REMOVAL

1. Remove elements from vessel following element manufacturer's instructions. Clean off any excess lubricant from vessel inside diameter before removing elements. Elements must be removed in direction of feed flow.

CAUTION

Do not scratch or damage vessel bore when removing or installing elements.

WARNING

DO NOT PRESSURIZE VESSEL WITHOUT ELEMENTS INSTALLED OR OTHERWISE OPERATE VESSEL WITH PERMEATE PORT PRESSURE IN EXCESS OF 125 PSI. OPERATION IN EXCESS OF THIS PRESSURE COULD RESULT IN CATASTROPHIC PORT FAILURE.

STEP 3 ELEMENT LOADING

1. Examine inside diameter of the vessel for scratches or imperfections that may affect sealing capability of head or element seals. Corrosion deposits or other foreign matter, including any excess lubricant, should be removed as described in **Closing Vessel, Step 1** on page OM-13.
2. Flush out vessel with clean water to remove all dust and debris.
3. Examine membrane element surfaces for any imperfection which could scratch the vessel bore. Pay particular attention to edges of anti-telescope device (ATD/brine seal carrier). If any defects are found which cannot easily be corrected, contact the element manufacturer for corrective action.
4. Using an approximate 50% mixture of glycerine in water, lubricate the inside of the vessel. This may best be accomplished using a suitably sized swab soaked in the mixture. This procedure will ease membrane element loading and reduce chance of scratching the vessel bore.

NOTE

Alternate To Measurement Method

Insert a clean thrust ring into downstream end of vessel.

Insert head assembly, without quad seal or adapter, into downstream end of vessel.

Place the two square ended sections of locking ring into locking ring groove (with squared ends together, stepped side outwards.)

Load elements as described in 5. through 9.

Install upstream adapter per Step 4 (page OM-12) and head assembly, per section on "Closing Vessel."

Remove downstream head assembly. Reinstall head assembly plus adapter, per section on "Closing Vessel."

NOTE

If the brine seal is not installed on element and element supplier does not specify otherwise, a brine seal should be placed on upstream end of elements. Open side of seal must face upstream.

5. Load the first element into upstream end of the vessel. Leave a few inches of the element projecting from the vessel to facilitate interconnection to next element.
6. Apply O-lube sparingly to O-ring of interconnector (amount of O-lube should be just sufficient to give a lustre to the O-ring. Excess O-lube must be removed to prevent possibility of element contamination).
7. Assemble the interconnector to the loaded element.

CAUTION

Maintain element alignment carefully during assembly process. Do not allow element weight to be supported by interconnector.

Misalignment can result in damage to interconnectors or permeate tubes or to element outer surface.

8. Line up the next element to be loaded and assemble it to the interconnector already assembled on first element.
9. Push both elements into the vessel until a few inches are projecting from the vessel. Repeat loading process until all elements are installed.

NOTE

As final element is installed, the element stack must be pushed forward until the face of the downstream element is at dimension "D" as shown in table. Take care to avoid pushing elements too far as it can be difficult to push stack in reverse direction.

VESSEL TYPE DIMENSION "D"

(see Figure 2)

E8U	9.25 in.
E8L	9.75 in.
E8B	10.25 in.
E8S	11.25 in.
E8H	11.25 in.

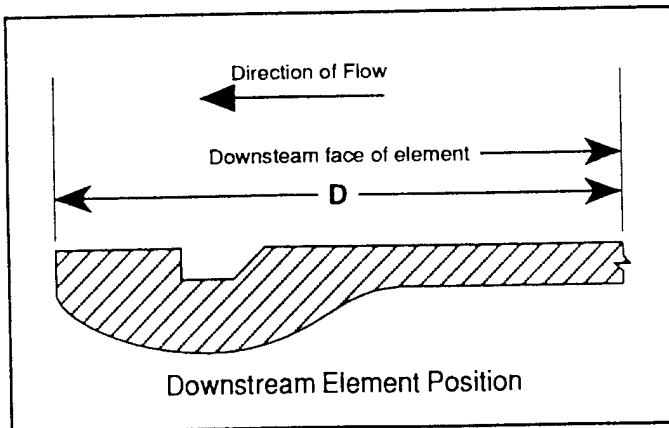


Figure 2

STEP 4 INSTALL ELEMENT INTERFACE HARDWARE

1. Assemble adapter to element permeate tube at each end of vessel.

WARNING

CONNECT THE CENTRAL (PERMEATE) TUBE OF THE MEMBRANE ELEMENT STACK, WITH AN ADAPTER ON EACH END, TO THE PERMEATE PORT IN THE HEAD AT BOTH ENDS OF VESSEL. PRESSURIZING VESSEL WITHOUT BOTH ADAPTERS INSTALLED COULD RESULT IN CATASTROPHIC FAILURE.

2. Install thrust ring at downstream end.

CAUTION

Install the thrust ring at the **downstream** end. Serious damage may result if thrust ring is not installed in correct location.



Installing thrust ring

NOTE

Ensure thrust ring is clean before installation.

Thrust ring requires no orientation; simply push into shell.

For step by step instructions on vessel closure, refer to the **Closing Vessel**, page OM-13.

CLOSING VESSEL

Step-By-Step Guide

NOTE

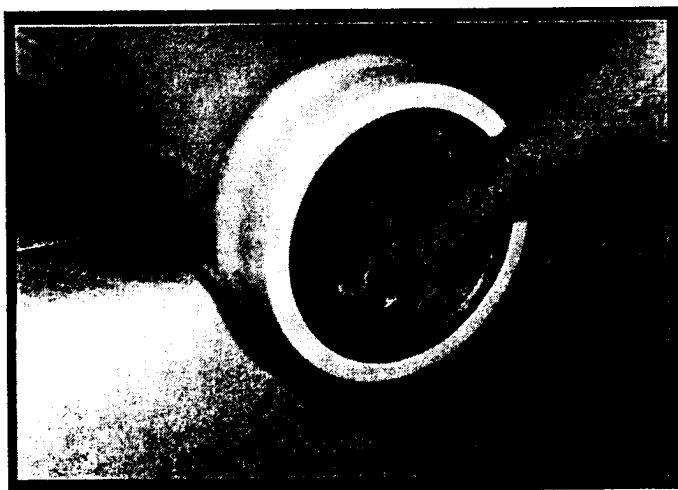
Read all guidelines in this section before attempting to close the vessel.

WARNING

CHECK THE HEAD ASSEMBLY FOR CORROSION AS DESCRIBED IN THE HEAD REBUILDING SECTION. CORRODED PARTS CAN RESULT IN CATASTROPHIC FAILURE.

KEEP PORT NUT SNUG. (E8L/B/S/H ONLY – NUT HAS LEFT HAND THREAD!) IF NUT LOOSENS, FEED/CONCENTRATE PORT RETAINERS MAY FALL OUT OF POSITION RESULTING IN CATASTROPHIC RELEASE OF PORT.

DO NOT PRESSURIZE THE VESSEL UNTIL AFTER VISUALLY INSPECTING TO ENSURE THAT ALL THREE SEGMENTS OF THE LOCKING RING SET ARE FULLY SEATED AND HELD IN PLACE BY THE SECURING RING AND SCREWS.



Cleaning vessel inside surface

NOTE

A small Phillips screwdriver or a piece of coat hanger works well to clean drain hole.

Ensure that drain hole is kept in the 6 o'clock position.

PRELIMINARY STEPS

Do not proceed until...

1. Elements and adapters have been installed in vessel following guidelines in **Replacing Elements**.
2. Head has been checked for correct component assembly by following step-by-step instructions in **Head Rebuilding**.
3. Vessel has been shimmed to prevent movement of the membrane elements if required. See page OM-33 of the trouble shooting section for a description of when shimming is required.

STEP 1 INSPECT SHELL INSIDE SURFACE

1. Inspect the vessel inside surface for any corrosion deposits or other foreign matter. If any are found, clean the surface as follows:
 - A. Using a medium or finer grade of Scotchbrite™ and a mild soap solution, clean each end of the vessel liner surface up to 8" in from each end of vessel.
 - B. Rinse away all loosened deposits from shell inside surface.
 - C. Using a small diameter rod, remove any debris which may be lodged in the drain hole.

2. Inspect vessel inside surface for scratches or other damage which could cause leaks. Vessels that leak must be replaced.

CAUTION

Never attempt to repair a fiberglass shell.

NOTE

Glycerin is a commercially available lubricant that will not foul membranes. However, silicone lubricant will better assist correct performance and ease head assembly, installation and removal.

STEP 2 SHELL AND HEAD SEAL LUBRICATION

1. Work O-ring lubricant into shell from half way up the bevel to approximately 1/2" in from the bevel. (See Figure 3)
2. Ensure entire head seal is covered with a thin layer of O-ring lubricant, with no dirt or dust contamination.

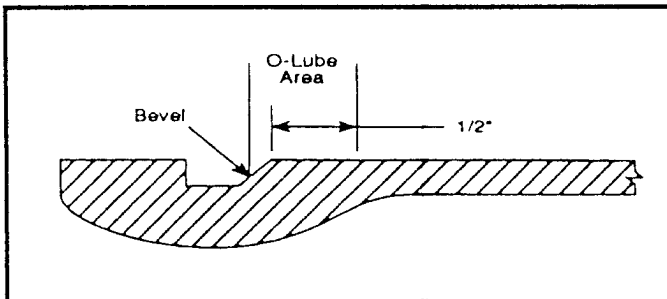


Figure 3

NOTE

Any remaining lubricant should be cleaned from vessel bore before applying fresh lubricant.

NOTE

In some installations it may be advisable to tighten a system-required permeate port nipple or fitting into Permeate port before head is assembled into the vessel.

CAUTION

Do not tighten a component into thermoplastic permeate port more than one turn past hand tight.

STEP 3 INSTALL HEAD

NOTE

If an E8 Series head tool (p/n 107028-1) is available, it can be used to ease head installation. (The tool can be obtained from Advanced Structures, Inc.) If a tool is not available, proceed as follows.

STEP 3A INSTALLATION BY HAND

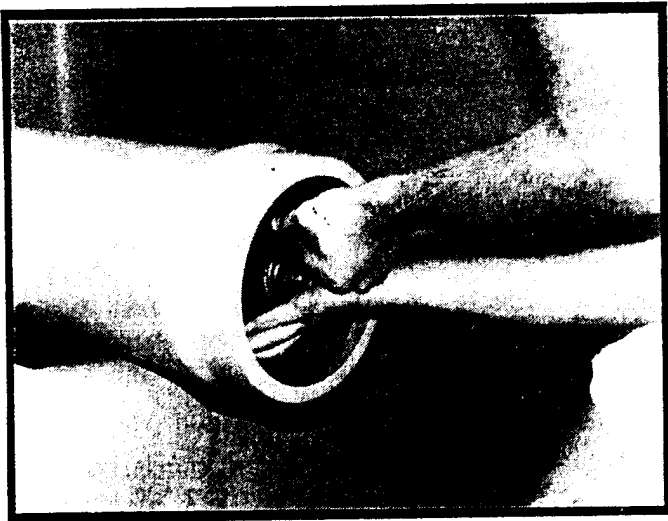
1. Align any previously placed index marks on head assembly and vessel body. This will ensure correct alignment for port connections. Do not rotate head assembly after insertion into vessel as this may cause head seal to become detached.
2. Hold head assembly square to axis of shell and slide it straight in until a slight resistance is felt.
3. Using both hands, firmly push head in as far as it will go (a sharp, forceful thrust may be necessary to enter head seal into vessel bore.) When head is in correct position, approximately 1/2" of groove will be exposed.

CAUTION

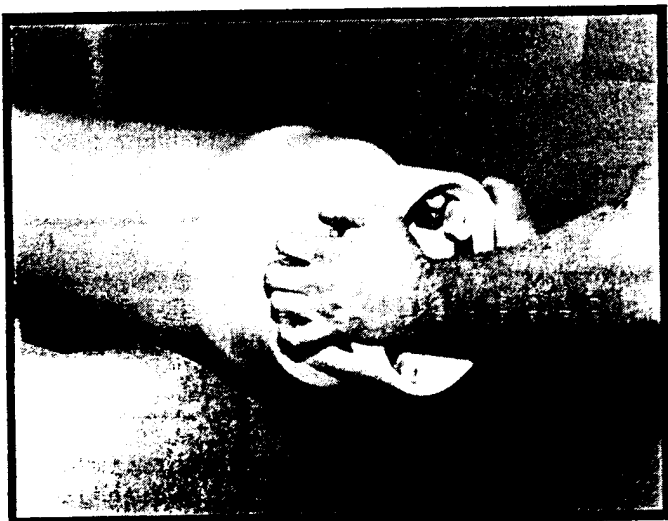
If head is allowed to rock side to side during installation, head seal may become detached.

STEP 3B INSTALLATION USING TOOL

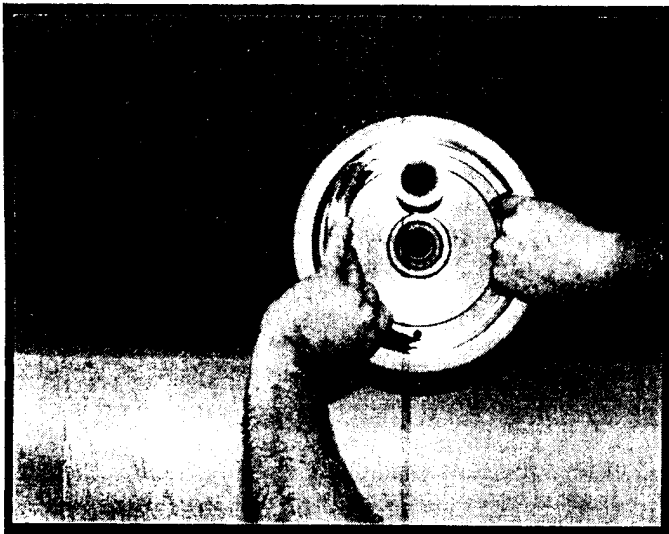
1. Align any previously placed index marks on head assembly and vessel body. This will ensure correct alignment for port connections. Do not rotate head assembly after insertion into vessel as this may cause head seal to become detached.
2. Hold the head assembly square to axis of the shell and slide it straight in until a slight resistance is felt.
3. Slide tool into shell just behind the head. Do not engage threaded rods.
4. Give a sharp, forceful thrust on the head tool to enter head into vessel bore. Then push into the shell as far as it will go. When head is in correct position, approximately 1/2" of the groove will be exposed.
5. Remove tool by pulling straight out. Do not rotate.



Installing head assembly — by hand



Installing head assembly — using special tool



Inserting key segment 'A'

STEP 4 INSTALL INTERLOCK

WARNING

INTERLOCKING COMPONENTS MUST BE CORRECTLY INSTALLED. INCORRECT ASSEMBLY OR INSTALLATION CAN RESULT IN CATASTROPHIC FAILURE.

CAUTION

Locking ring segments must be installed with stepped edge facing outwards.

1. Refer to **Figure 4** for correct segment identification.
 2. With the head assembly inserted into the shell, install segment **B** into the bottom of shell groove, with stepped edge facing outwards.
 3. Slide segment **B** counterclockwise making room to install segment **C** into the bottom of shell groove.
 4. Slide segments **B** & **C** in the shell groove until the square ends meet at the 3 o'clock position. Hold these in position while installing segment **A** (the key segment).
 5. Rotate the installed locking ring set counterclockwise until the square ends of segments **B** & **C** are in the 12 o'clock position. (This will prevent the segments from falling out.)
 6. Orient yellow securing ring cut-out around feed/concentrate port.
 7. Slide securing ring towards bearing plate until it contacts locking ring set.
 8. Thread all three securing screws into bearing plate 2 turns.
-
9. Using a screwdriver handle or similar object, tap all the way around securing ring to seat ring on bearing plate.
 10. Tightening securing screws until they are snug only. Overtightening may cause disassembly problems.

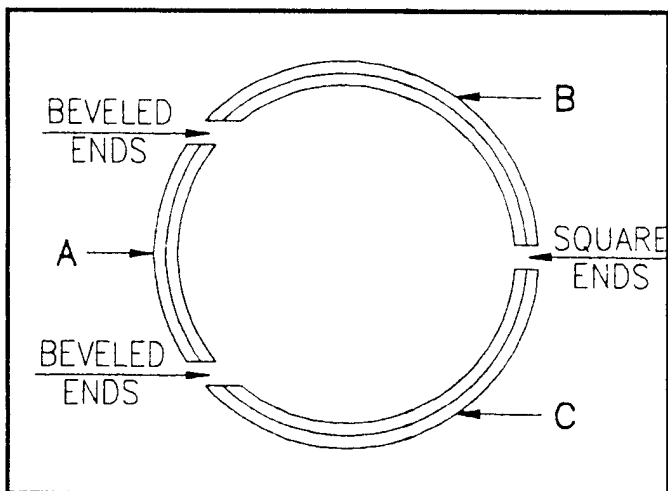


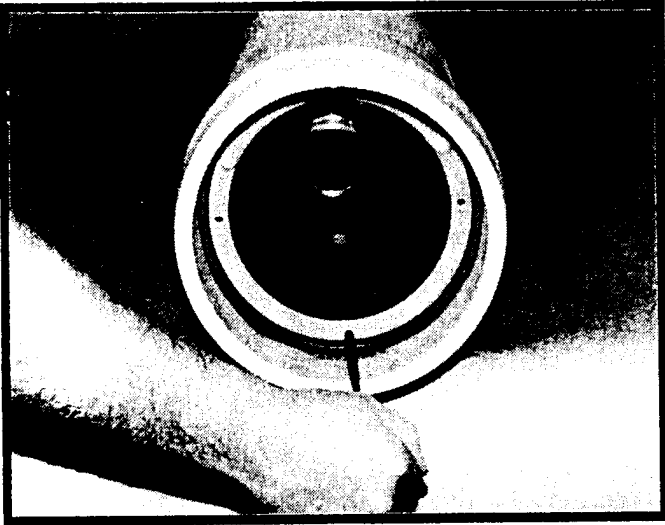
Figure 4

NOTE

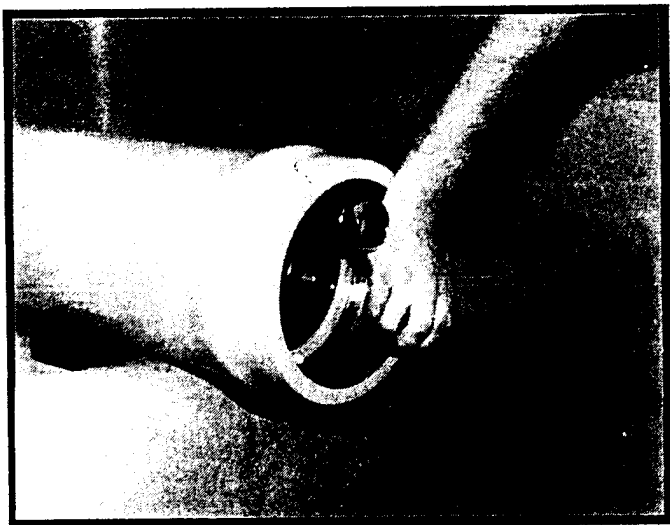
Before inserting securing screws, it is advisable to lightly coat the screw threads with anti-seize compound, to ease later disassembly.

NOTE

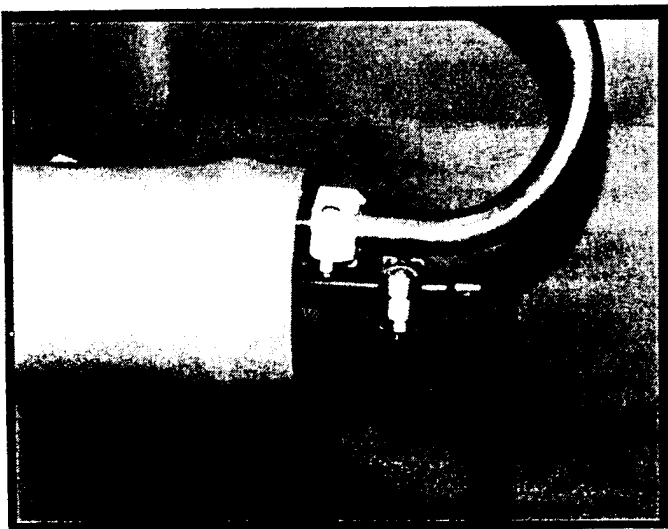
If holes in securing ring and bearing plate do not align precisely, reversing the securing ring should improve alignment.



Starting threads on securing screw



Tapping securing ring into position



Reconnecting ports

11. Visually inspect locking ring set to ensure it is correctly positioned between shell and bearing plate.
12. Verify that securing ring is fully seated and held in place by securing screws.

WARNING

INTERLOCKING COMPONENTS MUST BE CORRECTLY INSTALLED. INCORRECT ASSEMBLY OR INSTALLATION CAN RESULT IN CATASTROPHIC FAILURE.

STEP 5 RECONNECT PORTS

NOTE

Using teflon tape or anaerobic sealant on all threaded connections will help ensure a leak-free assembly.

1. Reconnect piping manifold to the vessel ports.

CAUTION

Do not tighten a component into thermoplastic permeate port more than one turn past hand tight.

STEP 6 PRE-PRESSURIZATION CHECKS

It is vitally important that the following checks be carried out before any attempt is made to pressurize the vessel.

It is recommended that the **Pre-Pressurization Checklist** (Page OM-4) be used to systematically verify that all steps have been performed.

HEAD ASSEMBLY

Verify that...

1. Head assembly is in good condition, with no evidence of damage or corrosion. See the sections on **Head Rebuilding and Maintenance**
2. Port nut is snug (E8L/B/S/H) (left-hand thread) or snap ring is in position (E8U).
3. Port retainers are correctly installed.
4. Locking ring set is properly in place and yellow securing ring is snugly held in place by the securing screws.

MEMBRANE ELEMENTS

Verify that...

1. Elements are installed in the vessel.
2. Element adapters are installed at each end of vessel.
3. Thrust ring is installed at downstream end of vessel.

PIPING CONNECTIONS

1. Check all piping connections to ensure that they will provide a leak-free seal.

STEP 7 PRESSURIZATION

WARNING

**DO NOT PRESSURIZE VESSEL
WITHOUT ELEMENTS INSTALLED.**

1. After following the above pre-pressurization checks, pressurize vessel in accordance with the element manufacturer's specifications.
2. Vessels should be filled slowly to assist trapped air to escape.
3. Vessels should be pressurized slowly to avoid damage to membrane elements and vessel components.

HEAD REBUILDING — E8U ONLY

Step-By-Step Guide

NOTE

*Read all guidelines in this section
before attempting to rebuild the head.*

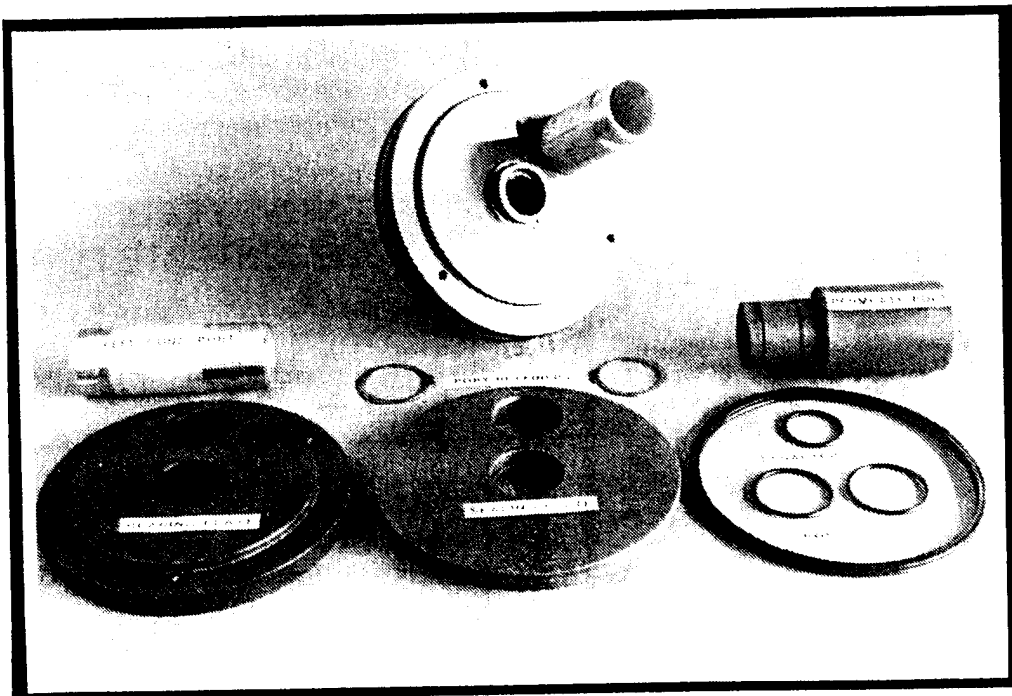
Head rebuilding should be performed in a clean work area. Dust or dirt on O-rings or other parts can scratch inner surfaces and cause subsequent leakage.

WARNING

DO NOT SERVICE ANY COMPONENT UNTIL YOU VERIFY THAT PRESSURE IS FULLY RELIEVED FROM THE VESSEL.

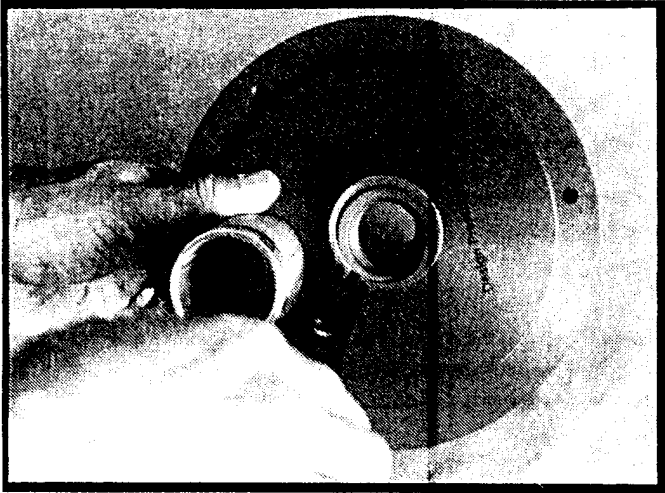
REPLACE ANY COMPONENTS NOT IN “AS-NEW” CONDITION. REUSING CORRODED OR DAMAGED COMPONENTS CAN RESULT IN CATASTROPHIC FAILURE.

SNAP RINGS MUST BE FULLY SEATED AT BOTTOM OF GROOVES PROVIDED. INCORRECT ASSEMBLY CAN RESULT IN CATASTROPHIC RELEASE OF PORT.

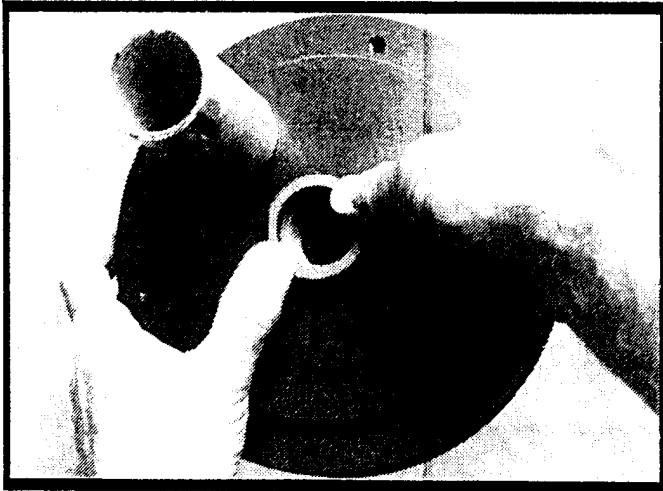


Head component identification (E8U)— head disassembled

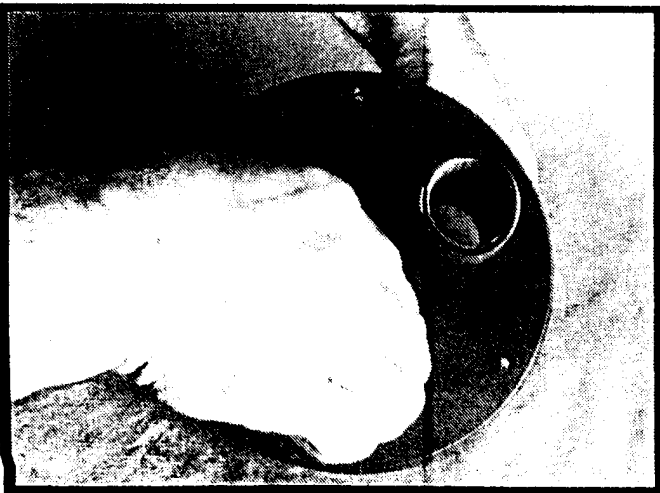
• E8U ONLY •



Snap ring removal using snap ring pliers



Pressing out (E8U) permeate port



Snap ring removal with pliers

PRELIMINARY STEPS

Do not proceed with step by step guidelines until...

1. All pressure has been relieved from the vessel, following system manufacturer's recommendations.
2. Head has been removed from the vessel following guidelines in **Opening Vessel**.

TO DISASSEMBLE HEAD

NOTE

Refer to pages OM-5 and OM-19 for head component identification.

CAUTION

It is recommended that safety glasses be worn during removal of snap ring.

STEP 1 REMOVE PERMEATE PORT

1. Remove snap ring using snap ring pliers.
2. Remove permeate port by pressing out from small end.

STEP 2 REMOVE SEALING PLATE

1. Hold feed/concentrate port and bearing plate stationary and rotate sealing plate slightly to break seal. Remove sealing plate.

STEP 3 REMOVE FEED/ CONCENTRATE PORT

1. Remove snap ring using snap ring pliers.
2. Remove feed/concentrate port from bearing plate.

NOTE

If necessary, ports may be tapped with a rubber mallet to ease removal.

Steps for rebuilding the head of the E8U continue on page OM-23.

HEAD REBUILDING — E8L/B/S/H ONLY

Step-By-Step Guide

NOTE

*Read all guidelines in this section
before attempting to rebuild the head.*

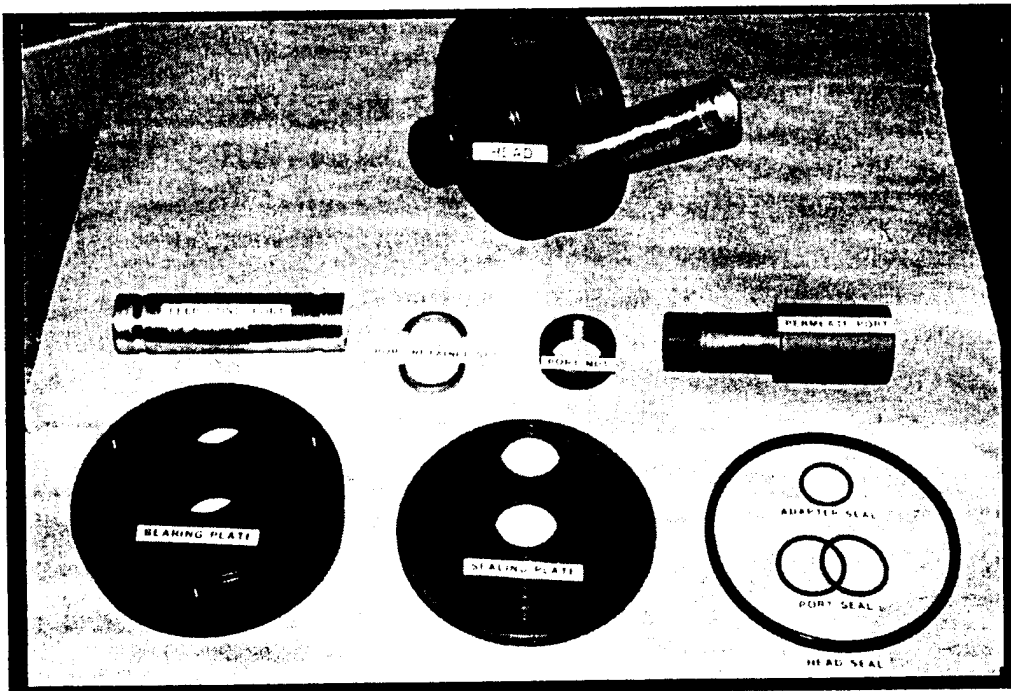
Head rebuilding should be performed in a clean work area. Dust or dirt on O-rings or other parts can scratch inner surfaces and cause subsequent leakage.

WARNING

DO NOT SERVICE ANY COMPONENT UNTIL YOU VERIFY THAT PRESSURE IS FULLY RELIEVED FROM THE VESSEL.

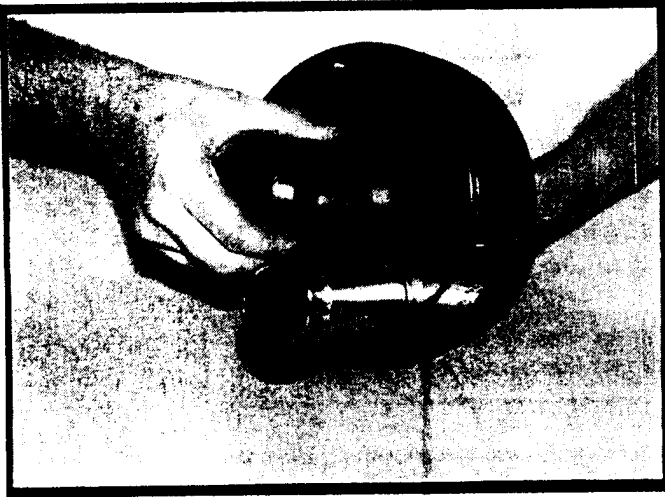
REPLACE ANY COMPONENTS NOT IN “AS-NEW” CONDITION. REUSING CORRODED OR DAMAGED COMPONENTS CAN RESULT IN CATASTROPHIC FAILURE.

UPON REASSEMBLY, PORT NUT MUST BE SNUG (LEFTHAND THREAD). IF NUT LOOSENS, FEED/CONCENTRATE PORT RETAINERS MAY FALL OUT OF POSITION RESULTING IN CATASTROPHIC RELEASE OF PORT.



Head component identification (E8L/B/S/H)— head disassembled

• E8L/B/S/H ONLY •



Removing port nut (left-hand threaded)

PRELIMINARY STEPS

Do not proceed with step by step guidelines until...

1. All pressure has been relieved from the vessel, following system manufacturer's recommendations.
2. Head has been removed from the vessel following guidelines in **Opening Vessel**.

TO DISASSEMBLE HEAD

NOTE

Refer to pages OM-5A and OM-21 for head component identification.

STEP 1 REMOVE PERMEATE PORT

1. Remove port nut by unscrewing left-hand thread.
2. Remove permeate port by pressing out from threaded end.

STEP 2 REMOVE SEALING PLATE

1. Hold feed/concentrate port and bearing plate stationary and rotate sealing plate slightly to break seal. Remove sealing plate.

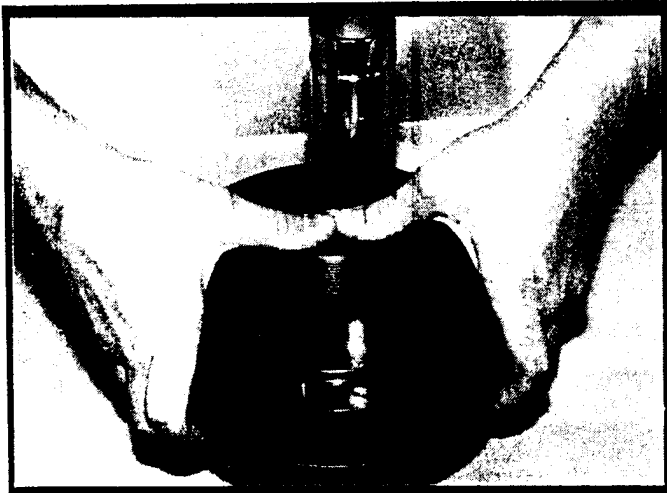
STEP 3 REMOVE FEED/ CONCENTRATE PORT

1. Press long, exposed end of feed/concentrate port further into bearing plate to free the port retainer set.
2. First remove port retainer set (2 pieces), then feed/concentrate port from bearing plate.

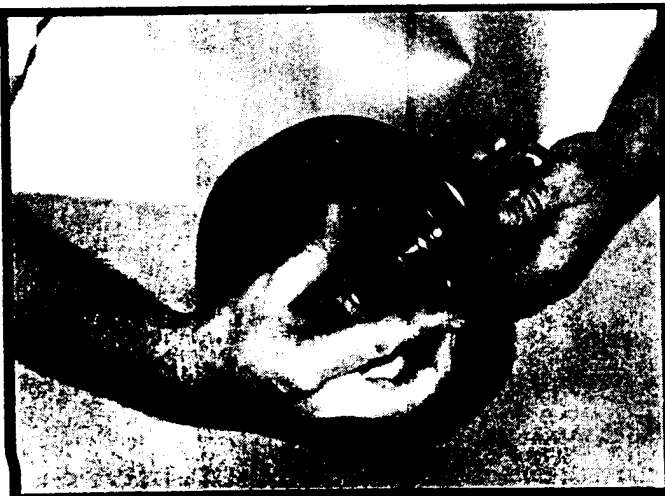
NOTE

If necessary, ports may be tapped with a rubber mallet to ease removal.

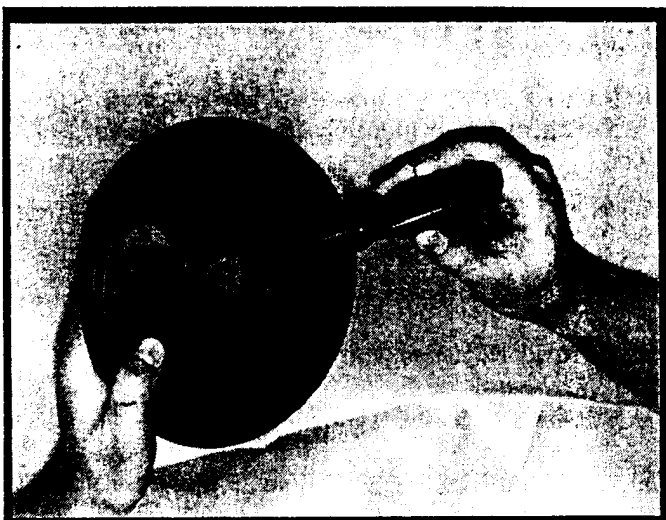
Steps for rebuilding the head of the E8L/B/S/H continue on page OM-23.



Pressing out permeate port



Removing port retainer set



Removing seals

STEP 4 REMOVE SEALS

1. Carefully remove 3 seals from the sealing plate and one seal from permeate port.

COMPONENT CLEANING AND EXAMINATION

STEP 1 WASH COMPONENTS

1. Wash all components in fresh water.
2. Blow components dry with compressed air, if available.

STEP 2 INITIAL COMPONENT INSPECTION

NOTE

A small screwdriver of similar tool may be used to remove O-rings. However, do not damage the sealing plate surfaces in any way or leakage may result.

It is recommended that all seals be replaced each time the head is assembled.

It is recommended that on E8U vessels, the snap ring be replaced each time head is assembled.

CAUTION

Read all guidelines in this section before making decisions on component structural or corrosion problems and treatment.

This section is intended only to provide guidelines in dealing with corrosion or component damage. In combination with good industrial practice, these guidelines provide a basis for safe system operation.

Any condition not covered in this section should be referred to Advanced Structures, Inc.

Corrosion in this context includes metal oxidation products and mineral deposits.

1. Examine all components for any damage that could affect structural strength or sealing properties.
2. Replace any parts considered to be structurally unacceptable.

THE FOLLOWING EXAMPLES INDICATE WHEN REPLACEMENT IS REQUIRED.

- A. **FEED/CONCENTRATE PORT** bent or distorted.
- B. **PERMEATE PORT** or **NUT** stripped or overstrained.

NOTE

Damage to anodized or plated parts may be temporarily sealed with epoxy paint while waiting for replacement parts.



Temporarily sealing damaged anodizing

NOTE

Alternate materials are available for high corrosion environments. Call Advanced Structures, Inc. for information.

- C. **PERMEATE PORT** internal thread stripped or overstressed.
- D. **BEARING PLATE** dented or distorted or with anodizing removed (possibly from being dropped or hit).
- E. **SEALING PLATE** cracked, distorted or with sealing area damaged.
- F. **PORT RETAINER SET** bent or distorted.
- G. **SECURING RING** cracked.
- H. **SECURING SCREWS** with stripped head or thread.
- I. **LOCKING RING SEGMENT** bent or damaged.

Any other detail consideration to be a potential problem should be referred to Advanced Structures, Inc.

STEP 3 EVALUATING CORRODED METAL COMPONENTS

CAUTION

This procedure is to be used on any corroded metal parts. If this fails to bring any component to "as-new" standards, the part must be replaced.

This procedure applies to the following parts:

- A. Locking ring set
 - B. Bearing plate
 - C. Feed/concentrate port
 - D. Port retainers
1. Examine all components for corrosion. For any components not in "as-new" condition, proceed as follows:
 - A. Loosen any large deposits with small wire brush.
 - B. Place components in shallow container of soapy water and scrub entire surface with medium grade Scotchbrite™ until all corrosion is removed.
 - C. Rinse components clean with fresh water.

NOTE

If any components are cracked, softened or discolored this may indicate a chemical resistance problem. These components must be replaced. Alternate materials may be required in these applications.

- D. Blow components dry with compressed air, if available.
- E. Re-examine components for damage that could affect structural strength or sealing properties. Any components not in "as-new" condition must be replaced.
- F. Inspect components for any condition that may have promoted corrosion, (e.g. gouged anodizing, inappropriate material selection, etc.)

STEP 4 REMOVING DEPOSITS FROM PLASTIC COMPONENTS

CAUTION

The following procedure should be used on all plastic components contaminated by mineral deposits or other foreign matter. If any component cannot be brought to "as -new" standards, it must be replaced.

This procedure applies to the following components:

- A. Securing ring
 - B. Port nut (E8L/B/S/H only)
 - C. Permeate port
 - C. Sealing plate
 - D. Adapter
1. Examine all plastic components for mineral deposits or other foreign matter. If any are found, proceed as follows.
 - A. Place components in shallow container of soapy water and scrub entire surface with medium grade Scotchbrite™ until all foreign matter is removed.
 - B. Rinse components clean with fresh water.
 - C. Blow components dry with compressed air, if available.
 - D. Re-examine components for any damage that could affect structural strength or sealing properties. Any components not in "as-new" condition must be replaced.



Lubricating seals

TO REASSEMBLE HEAD

WARNING

HEAD MUST BE CAREFULLY ASSEMBLED FOLLOWING THESE INSTRUCTIONS. INCORRECT ASSEMBLY CAN RESULT IN CATASTROPHIC FAILURE.

CAUTION

Use Parker Super-O-Lube™ sparingly on all seals each time the head is assembled. Excessive lubricant may foul membrane.

NOTE

It is recommended that all seals be replaced each time the head is assembled. A seal replacement kit is available from your supplier.

STEP 1 LUBRICATE AND INSTALL SEALS

1. Cover each seal with a thin, even layer of O-ring lubricant.
2. Install port seals in sealing plate and adapter seal in permeate port.

NOTE

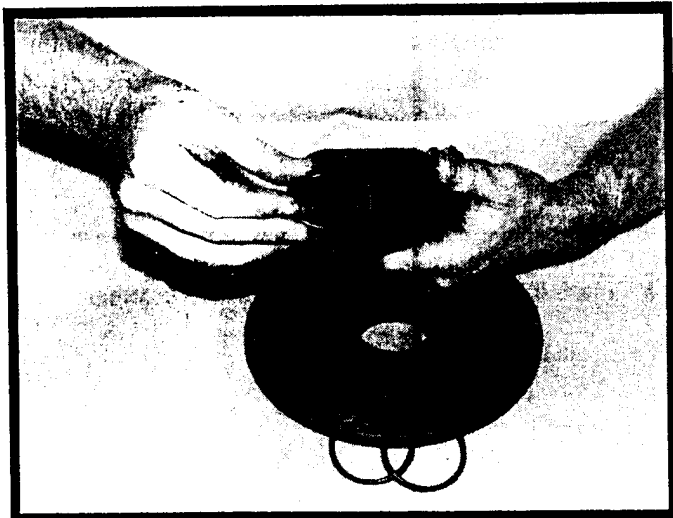
Glycerin is a commercially available lubricant that will not foul membranes. However, silicone lubricant, correctly used, will better assist correct performance and ease head assembly and disassembly.

STEP 2 INSTALL FEED/CONCENTRATE PORT

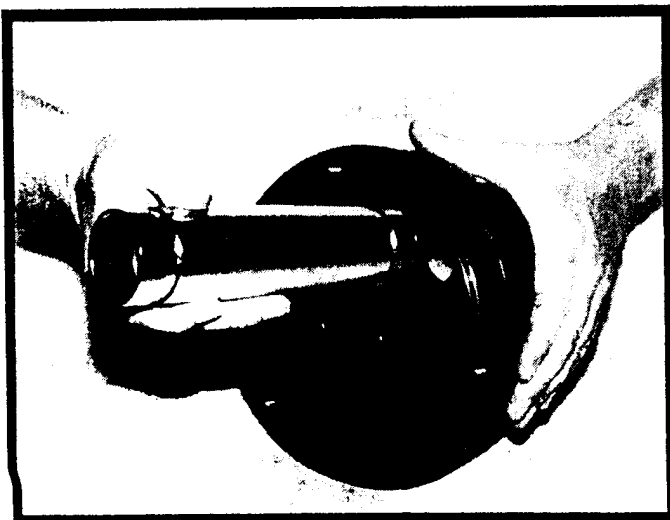
1. Hold the bearing plate so that the 6-1/2" diameter stepped surface is facing toward you. From this side, insert the smaller, machined end of the stainless steel feed/concentrate port through the off-center hole.

CAUTION

Steps for rebuilding the head of the E8U only continue on page OM-27. Steps for the E8L/B/S/H continue on page OM-28.



Installing seals



Installing feed/concentrate port

• E8U ONLY •



E8U port being fitted using snap ring pliers

CAUTION

It is recommended that safety glasses be worn during installation of snap ring.

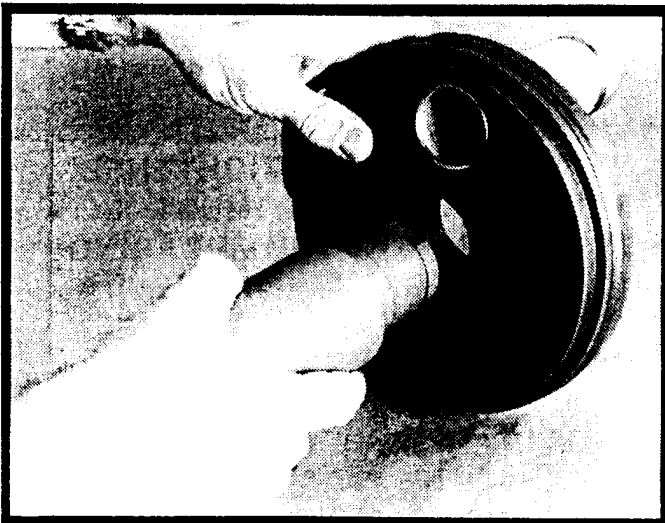
2. Install snap ring into groove in feed/concentrate port using snap ring pliers.

STEP 3 INSTALL SEALING PLATE

1. With its larger diameter facing the bearing plate, press the sealing plate onto the machined end of the feed/concentrate port.
2. Rotate sealing plate until the two center holes are aligned.

STEP 4 INSTALL PERMEATE PORT

1. From sealing plate side, insert threaded end of permeate port through bearing/sealing plate combination. Press firmly until permeate port bottoms on sealing plate.
2. Install snap ring into groove on outer end of permeate port using snap ring pliers.



E8U permeate port being inserted

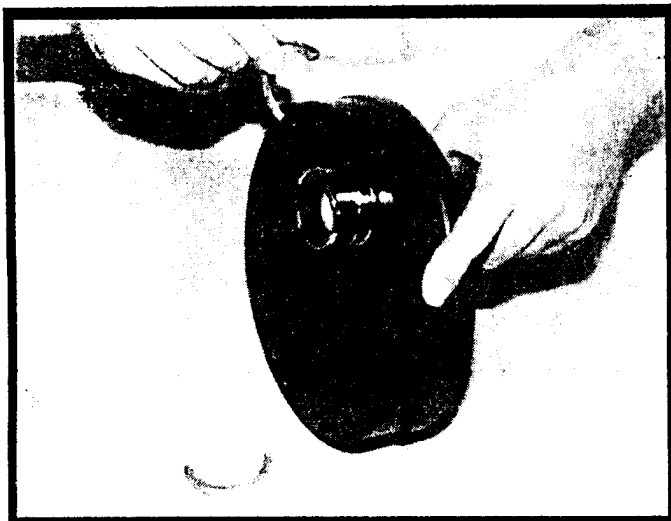
WARNING

SNAP RINGS MUST BE FULLY SEATED AT BOTTOM OF GROOVES PROVIDED. INCORRECT ASSEMBLY CAN RESULT IN CATASTROPHIC FAILURE.

NOTE

Head rebuilding of the E8U is now complete.

• E8L/B/S/H ONLY •



Installing port retaining set

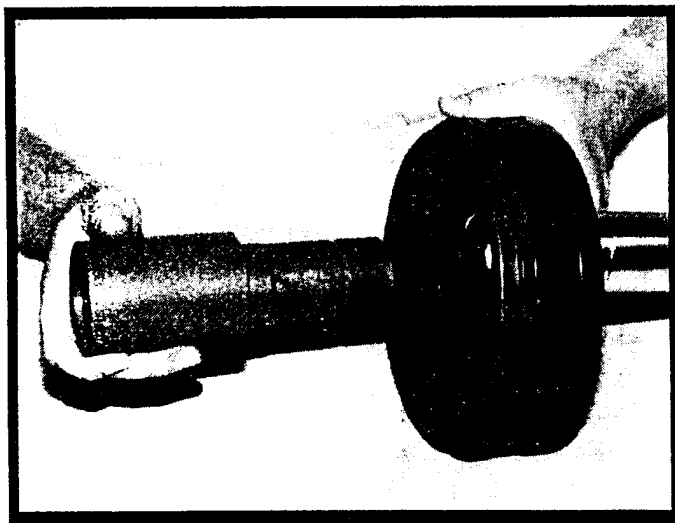
2. Install the port retaining set into the groove in the machined end of the feed/concentrate port. Pull port back until retaining ring set bottoms in bearing plate recess.

STEP 3 INSTALL SEALING PLATE

1. Hold these components together so the retaining ring set remains firmly seated. With its larger diameter facing the bearing plate, press the sealing plate onto the machined end of the feed/concentrate port.
2. Rotate sealing plate until the two center holes are aligned.

STEP 4 INSTALL PERMEATE PORT

1. From sealing plate side, insert threaded end of permeate port through bearing/sealing plate combination. Press firmly until permeate port bottoms on sealing plate.
2. Thread port nut (left-hand thread) onto permeate port. Tighten until snug.



Installing permeate port

WARNING

WITH THE PORT NUT TIGHTENED, THE SEALING PLATE MUST SIT FLUSH AGAINST THE BEARING PLATE. IF ANY GAP IS EVIDENT, THE COMPONENTS HAVE NOT BEEN ASSEMBLED CORRECTLY.

INCORRECT ASSEMBLY CAN RESULT IN CATASTROPHIC FAILURE.

NOTE

Head rebuilding of the E8L/B/S/H is now complete.

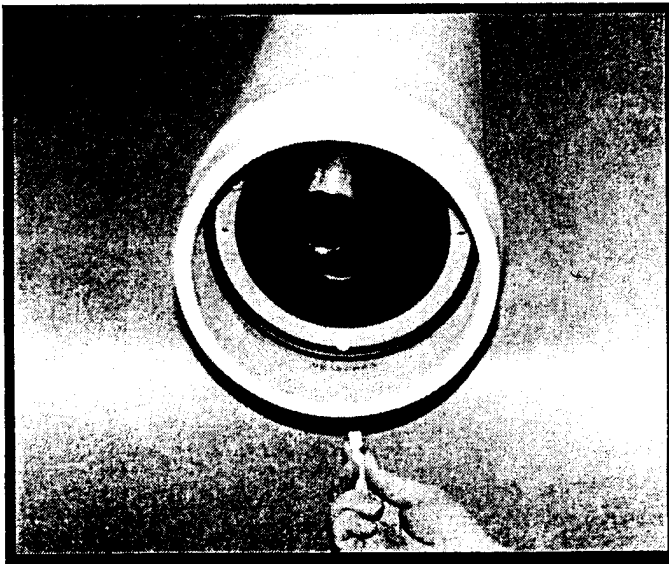
PREVENTIVE MAINTENANCE

Corrosion prevention is essential for the maintenance of safe operating conditions and to ease membrane element servicing.

Attention to the points listed below will enhance long-term safe operation and will ease servicing.

For suggestions on cleaning corrosion deposits from the vessel inside surface, refer to **Closing Vessel**.

For suggestions on cleaning corrosion deposits from head components, refer to **Head Rebuilding**.



Ensuring drain hole is free and in 6 o'clock position

PREVENTION CHECKLIST

- End closures. Inspect for components that may have deteriorated. Replace as needed.
- Keep external head assembly components as dry as possible.
- Do not tolerate leaks.
- Keep drain hole free of debris and maintain in 6 o'clock position.
- Ensure that protective coatings are intact. Exposed metal may promote corrosion.

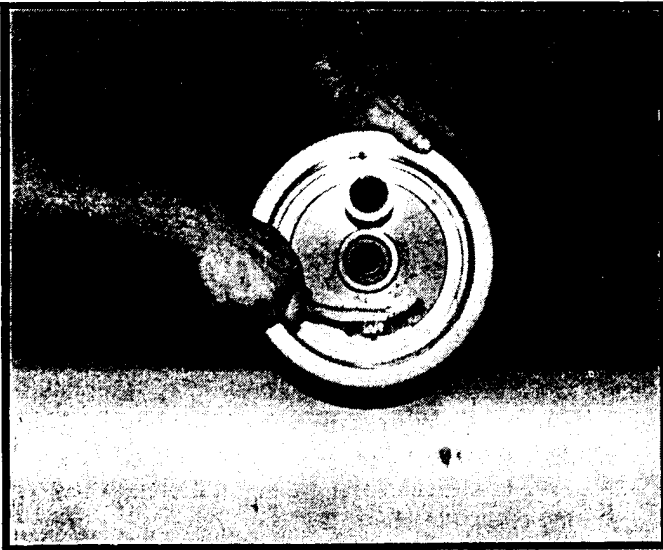
CAUTION

Any leakage indicates a potentially dangerous condition. Failure to eliminate leakage may void the warranty and could result in vessel failure.

TROUBLESHOOTING

This section is intended only to provide guidelines for dealing with problems that might arise while working with Advanced Structures pressure vessels.

These guidelines are not in any way a replacement for the good industrial practice required to ensure safe operation. We recommend that only a qualified mechanic experienced in servicing high pressure hydraulic systems carry out the following tasks.



Loosening Deposits

PRELIMINARY INSPECTION

Inspect the vessel at each end for corrosion which may interfere with head assembly removal. If corrosion is evident, proceed as follows:

1. Loosen any deposits with a small wire brush and/or a medium grade piece of Scotchbrite™.
2. Flush away loosened deposits with clean water.
3. Proceed with instructions given in **Opening Vessel** section.

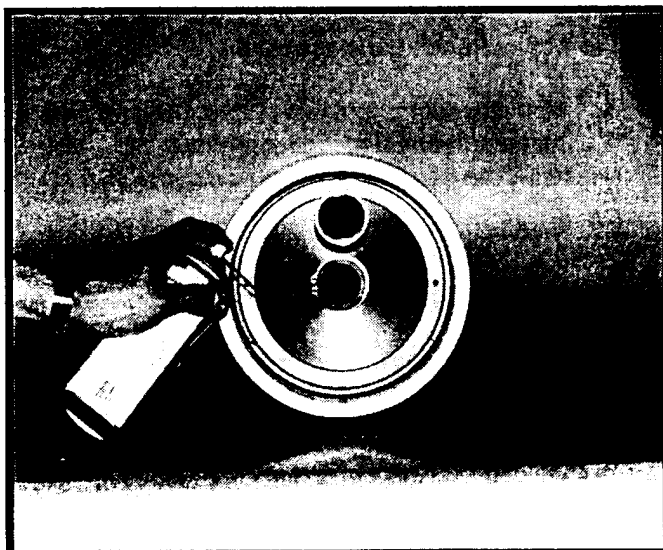
DIFFICULTY IN OPENING VESSEL

CAUTION

When applying penetrating fluid, be careful to avoid element contamination.

NOTE

Recommendations listed below are intended only as a guide. If the head assembly is still difficult to remove after all recommendations have been followed, call Advanced Structures, Inc. for technical assistance.



Applying penetrating fluid

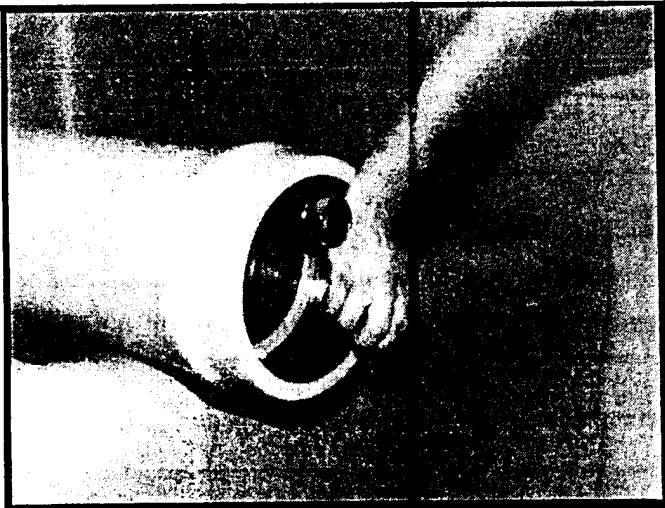
SECURING RING

1. Will not release from bearing plate after securing screws are turned 1/4 turn:
 - A. Apply penetrating fluid (such as WD-40™ or LPS-1™) to interfacing areas of securing ring. (Securing ring may have become bonded to locking ring set and/or bearing plate.)

- B. With a screwdriver handle or similar tool, tap the securing ring to release bond.
 - C. Again attempt to remove ring by turning screws an additional 1/4 turn.
2. Screws cannot be threaded through ring due to excessive corrosion or damage.
 - A. Insert Advanced Structures head tool (p/n 107028-1) into vessel so that threaded rods are aligned with threaded holes in securing ring.
 - B. Thread rods into securing ring as far as possible.
 - C. Pull on tool to remove securing ring.
 3. If neither screws nor head tool rods can be entered into threads in securing ring, attempt improvement by threading a 5/16-18 bottoming tap into the hole. Then repeat steps 1 or 2 above.

LOCKING RING SET

1. Will not rotate in shell:
 - A. Apply penetrating fluid (such as WD-40™ or LPS-1™) around locking ring set at the shell and bearing plate interfaces.
 - B. Use a cushioned mallet or hammer in conjunction with a wood block to tap the face of the bearing plate and locking ring segments.
 - C. Again attempt to rotate the locking ring set.
2. Will not rotate after above steps:
 - A. Abandon attempts to rotate the locking ring set and concentrate on direct segment removal. This will require extreme caution to avoid damage to vessel.



Tapping locking ring set



Direct segment removal

3. Direct segment removal:
 - A. Apply penetrating fluid to segment interface areas.
 - B. Allow fluid to penetrate.

CAUTION

In the following step, exercise extreme caution to avoid damaging the vessel shell.

- C. Insert blade of a small flat-head screwdriver between key locking ring segment and shell inside diameter.
- D. Tap screwdriver handle gently. This should release the segment from the shell. Repeat on other segments, if necessary.

HEAD ASSEMBLY

1. Will not release from shell even with use of head puller tool (p/n 107028-1):

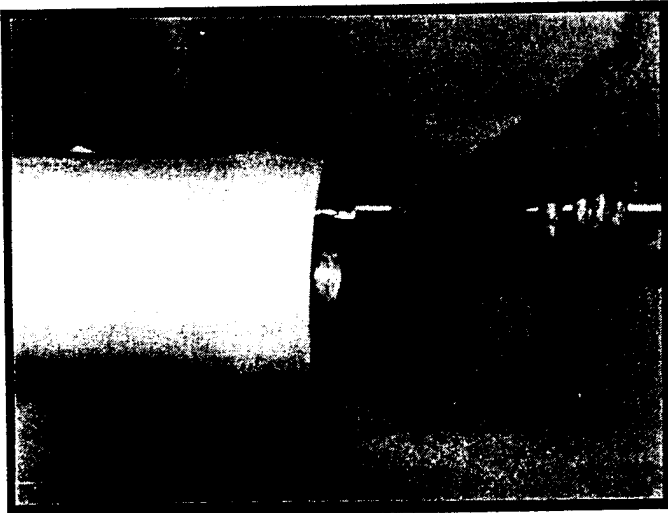
CAUTION

In the following step, exercise extreme caution to avoid damaging inner vessel surface.

- A. Insert a 1" diameter rod approximately 2 feet long into the feed concentrate port.
- B. Carefully rock the head assembly back and forth to release the seal.
- C. Once the head seal has been broken, complete removal as instructed in **Opening Vessel**.

NOTE

If head assembly is still difficult to remove after all recommendations have been followed, call Advanced Structures, Inc. for technical assistance.



Freeing head seal

SUDDEN DROP IN PERMEATE QUALITY

If a system is started and stopped frequently and no provision is made to raise the pressure slowly, movement of the membrane column may damage O-ring seals and reduce permeate quality.

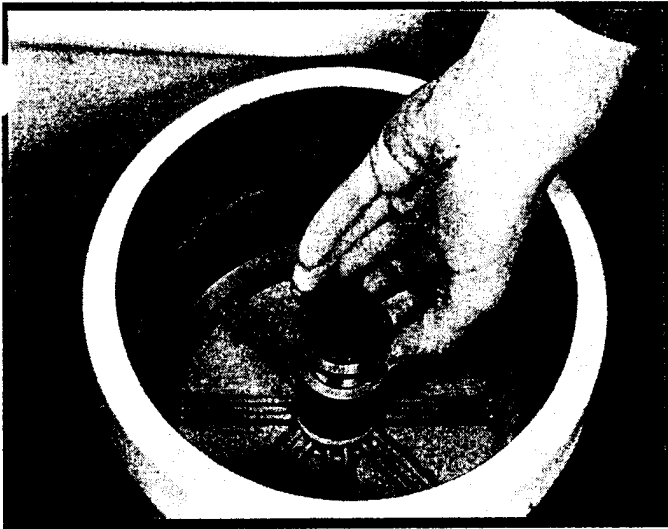
If the quality of the permeate suddenly drops off, and poor membrane performance is not suspected, remove the head per instructions in the User's Guide (See OPENING VESSEL section on pages OM-6 through OM-8). Remove the adapters from each end of the vessel. Remove the PWT seals from the adapters and the adapter seal from each of the permeate ports. Inspect these O-ring seals carefully for breakage or other damage. If the seals have rolled out of the groove, or are damaged, this may indicate excessive movement is occurring during startup and shutdown. To overcome this problem, the vessel should be shimmed to minimize this movement. Follow the procedure for shimming as given below:

SHIMMING

Shimming is accomplished by placing spacers between the adapter and the hub on the permeate port on the upstream end of the vessel. When done properly, shimming will prevent excessive movement of the membrane elements and the adapters, thus preventing potential damage of the O-ring seals. The spacers used for shimming are shaped like a plastic washer and are 0.20 inches thick.

The suggested procedure for shimming is as follows:

1. With the membrane properly loaded, install the adapters and place the thrust ring in the downstream end of the vessel. (See REPLACING ELEMENTS section on pages OM-9 through OM-12).
2. Install a head in the downstream end of the vessel following Steps 1 through 4 of the section entitled CLOSING VESSEL on pages OM-13 through OM-17).
3. Remove the adapter seal and head seal from the remaining head. Install the head far enough into the upstream end of the vessel so that you can place a locking ring segment in the locking ring groove. This will assure that there is no interference in any of the components and establish the force required to seat the head.



Sliding spacers onto adapter

4. Remove the head and slide some spacers over the end of the adapter that fits into the permeate port. Add enough spacers so that when the head is installed, it is not possible to install the locking segments in the groove. This will normally require 2 to 3 spacers.
5. Remove one spacer at a time until it is just possible to install the locking segments in the shell groove with the head in place.
6. Remove the head and reinstall the adapter seal and head seal.
7. Now close the vessel according to the VESSEL CLOSING section which begins on page OM-13.

INSTALLATION GUIDE

Proper vessel handling and installation are important to safe use and long vessel life. These guidelines outlined herein should be followed carefully; however, they are intended only as guidelines and do not relieve the purchaser from full responsibility for proper inspection, handling and installation. Damage due to improper handling or installation is the sole responsibility of the purchaser.

Improper assembly, misuse or corrosion damage can result in mechanical failure, property damage and serious injury or death. ***Read and follow all instructions carefully.*** Pay particular attention to the safety precautions given in this **Operation and Maintenance** section. Should any information in this guide not agree with the system supplier's instructions, call Advanced Structures, Inc. for clarification.

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HANDLING AND RECEIVING

Fiberglass reinforced plastic (FRP) pressure vessels are extremely rugged and durable. They are designed for safe, long-term service when they are handled and installed properly. However, damage to the vessel shell or related components from improper handling or installation could result in malfunction or catastrophic failure while in service. Therefore, exercise the following precautions whenever handling vessels.

1. Never lift or move a vessel by placing anything inside it. The vessel is durable and ideally suited to its purpose, but it can be permanently damaged by careless handling.
2. Be careful not to scratch the inside wall of the shell, especially in the O-ring sealing area inboard of retaining ring groove near each end.
3. DO NOT drop vessel or allow it to hit hard on the ground or against other objects.
4. DO NOT apply undue stress to shell.
5. Before using a forklift to handle the vessel, pad the forks to lessen the chance of damaging the shell. Severe scratches or gouging of the vessel can result in failure of the vessel wall.

NOTE ON IMPACT DAMAGE

Exterior vessel damage can lead to early vessel failure. Damage received in shipment should be reported to the shipping company immediately upon receipt. Minor damage such as scratches that go no deeper than the paint may be acceptable. Call Advanced Structures Customer Service for advice if in doubt.

MOUNTING SHELL

This section is concerned with the mounting of E8 Series pressure vessels only.

These guidelines must be integrated with any additional procedures required for specific installation.

Installation Guidelines:

1. Provide adequate room for servicing at both ends of vessel. Elements are installed from the upstream end, pushed through towards the downstream end and, eventually, removed from downstream end.
2. Follow all applicable handling guidelines. (Page I-2)
3. Position each vessel on its mounting frame such that it is centered between headers.

NOTE

It is important that each vessel be placed to minimize any strain on the tubing which connects a vessel to a header. Normally each vessel should be placed such that dimension from the vessel retaining ring groove to U-bend/header connection point be equal at both ends. However, if U-bends are not symmetrical at both ends, the vessel may need to be positioned off center such that connections can be made easily, without undue strain, at both ends of the vessel.

4. Mount vessels on urethane saddles positioned in line with pre-drilled frame holes for -1 through -5 vessels. The holes should be drilled at approximate center span 'S'. For -6, -7, -7.5 and -8 vessels, holes should be drilled within 10" to 30" from ends of vessel and a third saddle and strap, should be placed at mid span. These dimensions are shown on the corresponding engineering drawing.

WARNING

DO NOT MOUNT VESSEL RIGIDLY. RESTRICTED EXPANSION CAN RESULT IN DAMAGE TO THE VESSEL. SEE ELASTICITY AND MOUNTING REQUIREMENTS IN THE APPLICATION SECTION FOR FURTHER DETAILS.

5. Place mounting straps over vessel with cork strip against vessel.
6. Provide adequate room for servicing at both ends of vessel. Elements are installed and removed in the direction of feed flow.
7. Position screw through the frame mounting holes into strap nuts and run up to the frame finger tight.
8. Using a wrench, tighten mounting bolts **one** additional full turn. This should result in 25-50 lbs-in. of torque.

CAUTION
To avoid damage to vessel shell DO NOT over-tighten mounting nuts.

PIPING CONNECTIONS

The following are suggested guidelines to ensure that the vessel is allowed to expand and is easily serviced.

1. Support the header independently; support the branch with the header and the vessel.
2. Include an expansion loop in the branch connection to allow for:
 - A. Elastic growth in vessel length
 - B. Thermal growth in vessel length
 - C. Sagging of the vessel (which can occur even when supported at recommended span.)
3. The recommended branch connection is a U-bend pipe with flexible connections at each end, or a flexible hose.
4. The total weight of the branch connection and fittings should not exceed 16 lbs. for feed/concentrate and 8 lbs. for permeate port for E8 Series vessels.

APPLICATION GUIDE

This **Application Guide**, together with the **Installation Guide** and the **Operation and Maintenance Guide**, outlines the general conditions for safe use of E8 Series pressure vessels. Because of the considerable risk inherent in high pressure systems, it is the purchaser's responsibility to evaluate carefully each specified application to ensure that the E8 vessel selected is appropriate to that application.

Advanced Structures, Inc. will assist the purchaser in determining the suitability of the standard vessel for their specific operating conditions. For non-standard applications, alternate materials are available on special order. The final determination, however, including evaluation of the standard materials of construction for compatibility with the specific environment, is the responsibility of the purchaser.

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SUITABILITY FOR INTENDED USE

E8 Series RO pressure vessels are designed for continuous, long-term use as housings for reverse osmosis membrane elements. Models are available for 250, 400, 600, 1000 and 1200 psi. Any make of eight inch nominal diameter spiral wound element is easily accommodated.

In an RO system there is considerable potential for catastrophic failure, with consequent serious injury or loss of life. All decisions as to suitability for use must include full consideration of the various safety aspects involved. These include, but are not limited to:

- Process fluid compatibility (e.g. chemical and temperature considerations).
- External environmental factors (e.g. corrosive atmosphere; remote or special environments where plastics might be undesirable; etc.).
- Abnormal back pressure which might result in pressurizing permeate port above 125 psi (alternate materials are available).
- Capability of the user to maintain vessel properly.
- Requirement for increased fire resistance in some circumstances (e.g. may preclude use of PVC for permeate ports).

Use of an Advanced Structures, Inc., pressure vessel for other than its intended application will void the warranty.

Advanced Structures, Inc. will assist the purchaser in determining the suitability of the standard vessel for their specific operating conditions. For non-standard applications, alternate materials are available on special order. The final determination, however, including evaluation of the standard materials of construction for compatibility with the specific environment, is the responsibility of the purchaser.

ELASTICITY AND MOUNTING REQUIREMENTS

Mounting design must allow for vessel expansion, 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 is typically up to .020 inch in diameter and up to 0.007 inch per foot in length. A six-element vessel, for example, would expand approximately .150 inch in length. The following suggestions will help to ensure the vessel is allowed to expand and will ease servicing.

1. Mount the vessel on the urethane support pads furnished. Do not mount directly to any rigid structure.
2. Use the stainless steel straps furnished. Straps should be tightened sufficiently to hold the vessel on the urethane support pads, but not so tightly as to restrict expansion. (A torque of 25-50 lbs-in. is sufficient.)
3. U-bolts should not be used for vessel mounting under any circumstances.
4. Provide a flexible piping connection to permit decoupling the header from the vessel. The recommended branch connection is a U-bend pipe with flexible connections at each end, or a flexible hose.
5. Do not hard plumb either end of vessel.
6. Support the header independently; support the branch with the header and the vessel.
7. Include an expansion loop in the branch connection to allow for:
 - A. Elastic growth under pressure.
 - B. Thermal growth in vessel length.
 - C. Sagging of the vessel (which occurs even when supported at two points at recommended span.)
8. The total weight of branch connection and fittings should not exceed 16 lbs for feed/concentrate ports and 8 lbs for the permeate port for E8 series vessels.

The above suggestions are intended to help prevent damage in typical applications. Unusual or special applications may involve other considerations, to be determined by the system designer.

CORROSION

Considerations relating to corrosion are an important factor in vessel application. Corrosion can result in catastrophic failure and/or cause difficulty in removing head components from the shell. Correct component material selection is essential for safe long-term use. Although the process fluid is the main consideration, external environmental conditions should also be taken into account.

All reasonable precautions should be taken to protect head assemblies from external wetting, particularly in corrosive atmospheres (e.g. salt water areas or acidic atmospheres such as near lead acid battery arrays, etc.). Leaks from vessel or nearby components which allow head parts to be routinely wetted should not be tolerated.

The following typical list of Advanced Structures, Inc. pressure vessel components shows the standard material of construction of each part. An evaluation of the possibility of corrosion damage to metal head interlock components is of critical importance. Alternate materials are available upon request.

Dwg. Ref.	Qty. Per	Part Name	Materials/Remarks
SHELL			
①	1	Shell	Filament wound epoxy/glass composite — Head locking grooves integrally wound in-place
HEAD			
②	2	Bearing Plate	6061-T6 aluminum alloy — hard anodized
③	2	Sealing Plate	PVC thermoplastic
④	2	Feed/Concentrate Port	Type 316 stainless steel
⑤	4	Port Retainer	Type 304 stainless steel — two identical pieces per set
⑥	2	Permeate Port	PVC thermoplastic
⑦	2	Head Seal	Ethylene propylene rubber — Quad ring
⑧	4	Port Seal	Ethylene propylene rubber — O-ring
HEAD INTERLOCK			
⑨	2	Locking Ring Set	6061-T6 aluminum alloy — hard anodized — three distinct pieces per set
⑩	2	Securing Ring	Reinforced plastic — color yellow
⑪	6	Securing Screw	316 SS 5/16-18 UNC x .75 lg. HSHCS
ELEMENT INTERFACE			
⑮	2	Adapter	Engineering thermoplastic
⑯	1	Thrust Ring	PVC thermoplastic — install downstream
⑰	2	Adapter Seal	Ethylene propylene rubber — O-ring
⑱	4	PWT Seal	Ethylene propylene rubber — O-ring
FOR REFERENCE ONLY			

NOTE: Reference Numbers 12,13, and 14 refer to vessel support items not relevant here and are not shown.

SAFETY

CAUTION

Pressure vessels may cause loss of life, severe bodily harm or property damage if not correctly installed, operated and maintained.

Safety in service of fiberglass pressure vessels depends on proper application, installation, operation and maintenance. This section is intended to provide guidance towards safe system design. The safety information given in the **Installation** and **Operation and Maintenance** sections should also be studied and used appropriately in conjunction with the precautions listed below.

DESIGN CONSIDERATIONS FOR SAFETY

Fluid Compatibility

The materials of construction selected must be compatible with the process fluid and with proposed preserving and cleaning fluids. Standard materials are listed on the engineering drawings. In cases where the standard materials are unacceptable, suitable alternates may be available.

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 catastrophic failure. Although each E8 vessel is tested to 1.5 times design pressure, long term operation above design pressure must be prevented. Permeate port pressure must not exceed 125 psi (with standard materials). Vessels should not be continuously operated at temperatures above 120°F.

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.

Mounting

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.

Drain Holes

The drain holes located at the retaining ring grooves must always be facing downwards and kept free of obstruction.

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).

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PRE-PRESSURIZATION CHECKLIST

Danger — High Pressure Device

This vessel may cause loss of life, severe bodily harm, and/or property damage if not correctly installed, operated or maintained. Read and understand all guidelines given before attempting to open, operate or service this vessel.

Failure to follow these guidelines and observe every precaution may result in malfunction and could

result in catastrophic failure.

Misuse, incorrect assembly or use of damaged or corroded components can result in high-velocity release of the end closure.

We recommend that only a qualified mechanic experienced in servicing high-pressure hydraulic systems, open, close and service this vessel.

This checklist is an operational aid intended to augment the detailed guidelines given in the E8 Series **Operation and Maintenance Guide**.

Note that the checklist alone does not include all the details needed for safe vessel operation. Use the checklist each time any service operation is carried out to ensure that each step is completed before pressurizing the vessel.

MEMBRANE ELEMENTS

- Installed per manufacturer's recommendations.
- Feed flow direction correctly noted and elements correctly oriented.
- Column of elements centered inside shell.

ELEMENT INTERFACE

- Adapters installed at both ends of element column.
- Thrust ring installed downstream from element column.

HEAD

- All components in as-new condition, clean and free of damage or corrosion.
- All components properly assembled with new, freshly lubricated seals.
- Port retainer for feed/concentrate port in correct position.
- Port nut snug—E8L/B/S/H (Note: left-hand thread).
- Permeate port snap ring installed—E8U.

HEAD ASSEMBLY INTERLOCK

- Locking groove at each end of shell clean, free of corrosion and/or delamination with outboard face of groove true and in sound condition.
- All components in as-new condition, clean and free of damage or corrosion.
- All three segments of the locking ring set fully seated and held in place by the securing ring and screws.

PIPING CONNECTIONS

- Properly secured.
- Leak free.

Assembled By: _____

Date Of Assembly: _____

Checked By: _____

Date of Inspection: _____

The following vessels listed by serial number below were serviced under this checklist:

ENGINEERING DRAWINGS

Model E8U	APX-4 to APX-5
Model E8L	APX-6 to APX-7
Model E8B	APX-8 to APX-9
Model E8S	APX-10 to APX-11
Model E8H	APX-12 to APX-13

E8 SERIES RO PRESSURE VESSEL COMPONENT LIST

ASI 1/96	PART NAME	E8U	E8L	E8B	E8S	E8H
	Bearing Plate	407082-1	407022-1	407017-1	407001-1	
	Sealing Plate	407002-1 O-Rings 225/442				
	Feed/Concentrate Port	407083-1	407018-1		407003-1	
	Feed/Concentrate Port Retainer	6CR003-187 (Snap Ring)	407233-1 (2-piece set)			
	Permeate Port	407084-1	407019-1 O-Ring 221		407004-1 O-Ring 221	
	Permeate Port Retainer	6CR003-187 (Snap Ring)	407005-1 (Port Nut)			
	Head Seal	6ER002-442				
	Port Seal (20/kit)	1ER001-225				
	Adapter Seal (20/kit)	1ER001-221				
	Locking Ring Set (3-piece)	407020-1			407006-1	
	Securing Ring	407007-1				
	Cap Screw	6CF016-1				
	Saddle – 2 each for -1 thru -6 3 each for -7 & -7.5	407157-1	407157-2	407157-3	407157-4	
	Strap Kit (2 per kit)	107070-1		107070-2	107070-3	
	Strap Screw (included above)	6CF007-12		6CF007-14	6CF007-16	
	Thrust Ring	407052-1				
	Head Puller	107028-1				
	Head Assembly (refer to drawing — includes items 2-9)	107033-1	107017-1	107018-1	107019-1	

Note: The numbers shown above are for ordering purposes only. Due to differences in assembly numbers and part numbers, the number stamped on a part may be different from the numbers shown above and may not always be reflected on the actual part. When appropriate, the part will be supplied with O-ring(s) lubricated and assembled to the part.

LIMITED WARRANTY

Advanced Structures, Inc. warrants to the purchaser that the goods supplied shall be free from defect in material or workmanship. If, within one year after date of invoice, any goods sold under this agreement or purchase order prove to be defective in material or workmanship upon examination by Seller, the Seller will supply an identical or substantially similar replacement part F.O.B. the Sellers' factory, or the Seller, at its option, will repair such part or give credit to the Buyer for such goods. Any replacement goods provided hereunder will be warranted against defects in material or workmanship for the unexpired portion of the one-year warranty period applicable to the goods.

The warranty will not be applicable if the goods have been subject to any accident, faulty installation, misapplication, abuse or misuse, if the Buyer has used the goods after discovery of a defect without Seller's prior written consent, or if the Buyer refused to permit the Seller to examine the goods to ascertain the nature of the defect.

This warranty is expressed in lieu of any and all other expressed or implied warranties with respect to the goods or their installation, use, operation, replacement or repair, including any implied warranty of merchantability or fitness of purpose. This agreement constitutes the entire contract and exclusively determines the rights and obligations of the Seller and the Buyer, any prior course of dealing, custom or usage or trade or course of performance notwithstanding. Seller is not liable for any special or consequential loss or damage resulting from the use or loss of use of the goods.

