



Wave Cyber (Shanghai) Co., Ltd.

8" End Port Membrane Housing User's Guide



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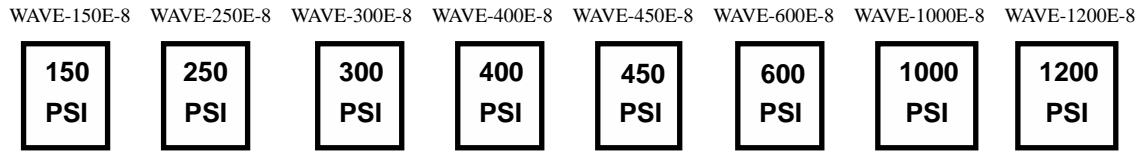
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SECTION 1

OPERATION/MAINTENANCE GUIDE



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, service or operate this vessel.

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

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

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

This section is a guide to proper operation and maintenance of Wave Cyber pressure vessel series. 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 technical specifications and dimensions, refer to the Engineering Drawing of each specific model.

The information in all sections must be carefully followed for the vessel to provide the safe, long service life for which it is designed.

Proper vessel handling and installation are important to safe use and long vessel life. These guidelines should be followed carefully; however, they 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 /Maintenance Guide section.** Should any information in this guide not agree with the system supplier's instructions, call Wave Cyber for clarification.

Corrections or recommendations for improvement of this manual should be addressed to:

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SECTION 2

PIPING CONNECTIONS

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

1. Support the header and interconnecting piping in a manner that they are self-supporting relative to the vessel.
2. Connecting piping alignment to feed, Concentrate and Permeate ports should not exceed 0.7 mm misalignment (Figure 1). If the misalignment exceeds 0.7 mm, please contact Wave Cyber for technical assistance.
3. Piping connections to the vessel's feed/concentrate ports should be via flexible Victaulic® couplings. To get maximum flexibility, install two Victaulic® couplings on each Feed/Concentrate port of the vessel.

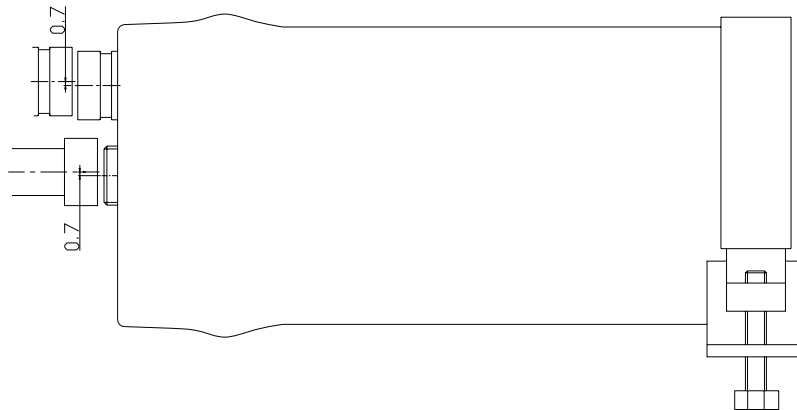


Figure 1

SECTION 3

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 0.8mm/m in diameter and up to 0.4mm/m in length. A six-element vessel, for example, would expand approximately 4.5mm 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 in-lbs. (11.3-22.7kgs) 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 Permeate Port connection is a U-bend pipe with flexible connections at each end, or a flexible hose. Recommended Feed and Concentrate connections are via two flexible Victaulic® couplings.
5. Do not hard plumb any piping connections to the vessel.
6. Support the header independently. Piping should be self supporting or supported by the headers.
7. Include an expansion loop in the branch connection to allow for:
 - A. Elastic growth under pressure.
 - B. Thermal growth in vessel length.
8. The total weight of branch connection and fittings supported by the vessel should not exceed 2 kg for the Permeate ports and 4 kg for the Feed/Concentrate for Wave Cyber 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.

SECTION 4

INSTALLATION GUIDE

A. Mounting Shell

This section is concerned with the mounting of Wave Cyber Series pressure vessels. These guidelines must be integrated with any additional procedures required for your specific installation.

Installation Guidelines:

1. Provide adequate room for servicing at both ends of vessel. Elements are installed from the upstream end (feed), pushed through towards the downstream end (concentrate) and, eventually, removed from the downstream end.
2. Follow the procedures in Section 3-Elasticity and Mounting Requirements.

NOTE
It is important that each vessel be placed to minimize any strain on piping/tubing that connects a vessel to a header. Normally each vessel should be centered in the frame with the feed and concentrate ports positioned such that piping/tubing connections can be made easily, without undue strain at each end of the vessel.

3. Mount vessels on urethane saddles (provided with the vessel) positioned in line with pre-drilled frame holes. For -1 through -3 vessels, holes for the mounting straps should be drilled at approximate center span 'S' (Figure 2). For -4 and -8 vessels, holes for the mounting straps should be drilled at span 'S' from the middle of the vessel and a third saddle, without a strap, should be placed at mid span (Figure 3). These dimensions are shown on the corresponding engineering drawing.

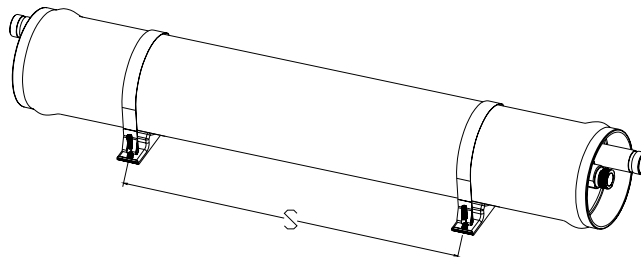


Figure 2

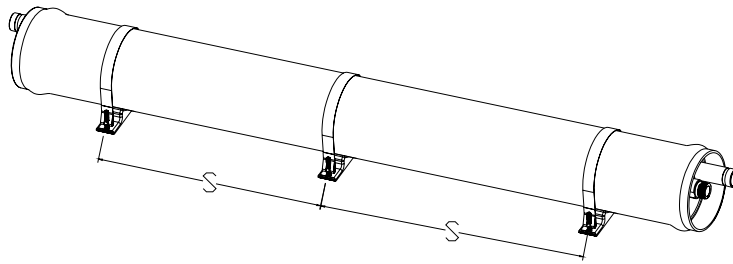


Figure 3

4. Connect the vessel to piping manifolds while adjusting the position of the shell and piping manifolds. Try to align the feed port and concentrate port. The distance between the vessel and piping manifolds should be set as 3 mm (Figure 4). Try to align in all directions. The Victaulic® coupling should be able to be tightened without applying any adhesive on it. Lock the vessel and piping manifolds in place only after all alignment procedures are finished.

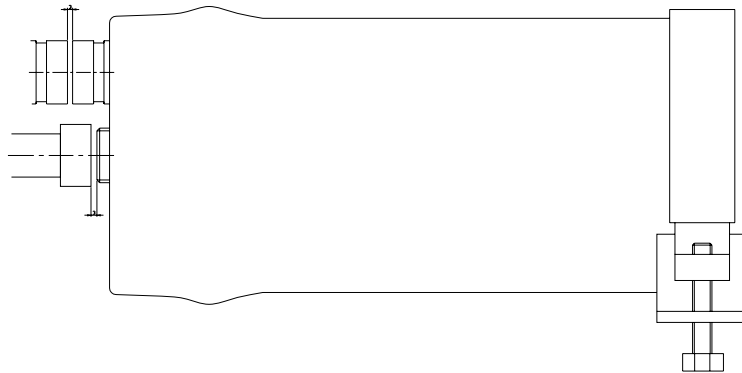


Figure 4

Warning

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

DO NOT TIGHTEN THE NUTS OVERLY, OTHERWISE THE VESSEL MIGHT GET DAMAGED.

5. Place mounting straps over 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. Connect vessel feed piping
9. Using a wrench, tighten mounting bolts one additional full turn. This should result in 25-50 in-lbs. (11.3-22.7kgs) of torque.

NOTE

Straps are designed to secure the vessels during operation. They are not designed to handle all loads that might occur during shipment. Appropriate vessel restraint should be employed considering such factors as the mode of shipment, distance to be traveled and the design of the system. The vessels and frame should be blocked to prevent any differential movement which could be caused by the forces experienced during shipment.

B. Element loading

1. Examine the 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.
2. Flush out the 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 can not be easily fixed, please contact element supplier for solution.
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: Standard O-Rings are EPDM and it is recommended that oil based lubricants **NOT** to be used with EPDM.)
5. Load the first element into the upstream end of the vessel. Leave a few inches of the element projecting from the vessel to facilitate interconnection to the next element.
6. Apply a light film of a non-petroleum based lubricant, such as glycerin, to the inter-connector O-ring. (The amount of lubricant should be just enough to give a lustre to the O-ring. Excess glycerin must be removed to prevent possibility of element contamination).
7. Assemble the inter-connector to the loaded element.
8. Line up the next element to be loaded and assemble it to the inter-connector already assembled on first element.

NOTE

Take care to avoid pushing elements too far as it can be difficult to push the stack in a reverse direction.

9. Push both elements into the vessel until a few inches are projecting from the vessel. Repeat loading process until all elements are installed.
10. When the final element is installed, push the element stack forward until the distance between the first (downstream) element and retaining ring groove is about 170 mm. (Figure 5.)

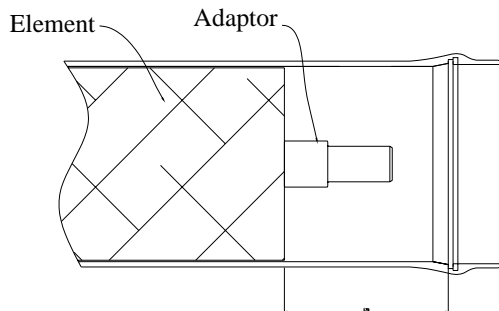


Figure 5

Warning

Connect the central (permeate) tube of the membrane element stack, with an adaptor on each end, to the permeate port in the head at both ends of vessel. Pressurizing vessel without both adaptors installed could result in explosive head failure.

Mounting element interface hardware

1. Put the adaptor/membrane PWT seal on the adaptor first.
2. Then install the adaptor into the membrane permeate tube.

Minimize the Gap between element and vessel

PVC washers should be used to minimize the gap before pressurizing (Figure 6). This is done to prevent the element from being damaged by movements inside the vessel.

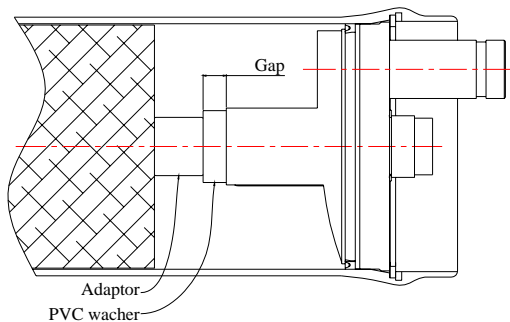


Figure 6

CAUTION

Excess gap inside the vessel may cause damage to the element in operation.

C. Mounting Head Assembly

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 mild soap solution, clean each end of the vessel liner surface up to 300 mm from each end of vessel.
 - B. Rinse away all loosened deposits from the shell inside surface using clean fresh water.
2. Inspect the vessel inside surface for scratches or other damage which could cause leaks. Vessels that leak must be replaced.
3. Inspect Feed/Concentrate port seals and attachments for internal and external damage or deterioration.

NOTE

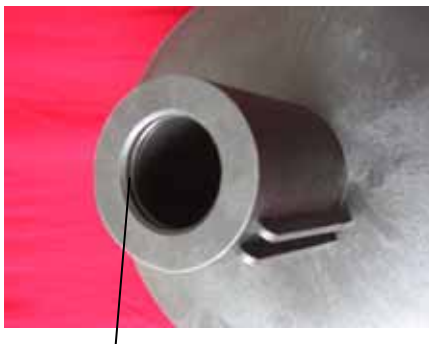
Contact Wave Cyber for guidance, if damage to the vessel's internal surface or Feed/Concentrate port, seals or attachments is discovered during inspection.

CAUTION

Never attempt to repair a fiberglass shell.

Step 2 Set Up Head Assembly

1. Place the adaptor/permeate port seal into permeate port seal groove located on inside of permeate port.
 - 1) Check to make sure adaptor O-ring is in place inside the permeate port.
 - 2) Secure the thrust cone in position on the permeate/seal plate.



PWT Seal



2. Attach the thrust cone onto the down stream permeate port.

Warning

Install the thrust cone on the **down stream**. If the thrust cone is not installed on the correct position, serious damage may be caused.

Step 3 Head Seal and Head Lubrication

1. Ensure that the head seal is covered with a thin layer of lubricant and is free from any dirt or dust contamination.
2. Then lubricate the whole head seal and the area where it will contact the head seal.

Note
Lubricate the seal with a little Non-Petroleum based lubricant, such as glycerin or other suitable silicon based lubricant. (Glycerin is a commercially available lubricant that will not foul membranes.)

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

Step 4 Install Head

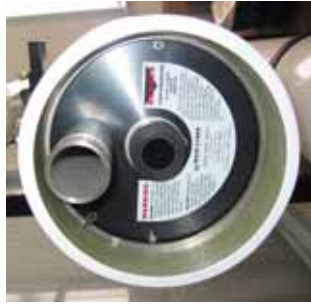
1. Holding the head square to the axis of the shell, slowly push the head into the shell until the seal passes the retaining ring groove and a slight resistance is felt.
2. As a resistance is felt, two hands may be required. Push the head into shell until the head clears the retaining ring groove. Head can be tapped lightly with a rubber mallet if necessary to seat the head into position.

Step 5 Install Interlock

1. Carefully wipe out any debris or moisture from the retaining ring groove. The groove must be clear and dry before proceeding.
2. With the head assembly installed in shell, place the tip of the head retaining ring in the stainless steel groove (The non bent tab end).
3. Begin pushing the retaining ring into the groove as you rotate your hand around the I.D. of the shell.
4. Continue until the entire retaining ring is installed in the groove.



5. Verify that the retaining ring is fully seated in the groove before proceeding.



Step 6 Connect Permeate Piping

1. Connect manifold piping to the vessel Permeate port.

NOTE

Using teflon tape or anaerobic sealant on all NPT and BSPP threaded connections will help ensure a leak-free assembly. Union fitting does not require teflon tap or anaerobic sealing.

WARNING

Don't overly tighten the thread, excessive force may cause the permeate port to crack.

Step 7 Pre-pressure Check

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

a. Head Assembly

Verify the following at each end of the vessel:

1. Head assembly is in good condition, with no evidence of damage or corrosion.
2. Retaining ring is properly in place.

b. Membrane Elements

Verify that...

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

c. Piping Connections

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

Step 8 Pressurization

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

Warning

DO NOT PRESSURIZE THE VESSEL UNTIL ELEMENTS AND THE RETAINING RING ARE PROPERLY INSTALLED.

D. Removing Head Assembly

Step 1 Relieve pressure

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

Step 2 Disconnect Permeate port

1. Disconnect and remove permeate piping from the permeate port of the vessel.

Step 3 Examine end closure

1. Examine end closure of vessel for corrosion. If any is evident, proceed as follows:
 - A. Loosen any deposits.
 - B. Flush away loosened deposits with clean water.

Step 4 Remove Retaining ring

Remove the retaining ring from the stainless steel groove inside the shell. Following is the procedure: Use a tool with a peaked head (such as pliers) and insert the peaked head into the hole on the head of the retaining ring. Raise the head of the retaining ring and move it out of the stainless steel groove (Figure 7). Pull the head of the retaining ring slightly out of the stainless steel groove with the left hand, meanwhile; rotate the retaining ring clockwise with the right hand until the entire retaining ring is pulled out of the stainless steel groove. Take care to avoid hitting or levering against the vessel, as this could result in delamination.

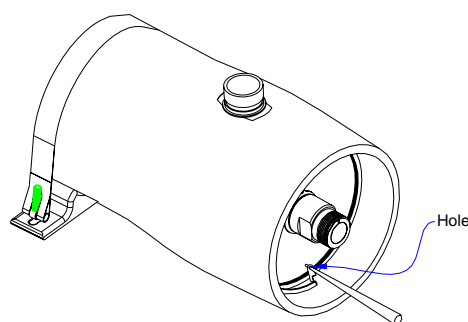


Figure 7

Step 5 Remove head

1. Add extension to permeate port or use head puller.
2. Pull the head assembly all the way out of the vessel.

Note
It may be necessary to rock the head slightly and/or tap the head inboard to break head seal bond. See trouble shooting section for more information.

SECTION 5

SUITABILITY FOR INTENDED USE

Wave Cyber MPV pressure vessels are designed for continuous, long-term use as housings for reverse osmosis membrane elements. Models are available for 150, 300, 450, 600 and 1000 PSI. The allowable temperature is -7°C ~ 49°C . Any make of eight inch nominal diameter spiral wound element is easily accommodated.

The filament wound FRP shell is composed of continuous fiber glass impregnated with heated epoxy resin system. The allowable water PH range is 3-10 under normal operating conditions and 2-12 if the vessel is periodically cleaned. Cleaning agents must be wiped off and cleaned from the vessel after periodical cleaning. For the material list of vessel, refer to the Engineering Drawing of each specific model.

In an RO system there is considerable potential for explosive head failure, which could result in 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 a Wave Cyber pressure vessel for other than its intended application will void the warranty.

Wave Cyber 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.

SECTION 6

SAFETY

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 Guide section 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 explosive head failure. Although each Wave Cyber MPV pressure vessel is tested to 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 without Wave Cyber's specific permission.

Over-pressure 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.

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).

SECTION 7

TROUBLESHOOTING

Problem	Possible Cause	Solution
1. The head leaks when testing pressure	<ul style="list-style-type: none"> a. Dust or dirt on the inside surface of the vessel, b. Inside surface of the vessel get damaged; c. Head seal gets damaged; d. The water temperature exceeds the max. operating temperature of the vessel. 	<ul style="list-style-type: none"> a. Remove the head and clean the dust and dirt; b. Contact Wave Cyber for assistance; c. Replace the seal; d. Lower the water temperature to below the max. operating temperature with auxiliary equipment.
2. Sudden Drop in Permeate Quality	<ul style="list-style-type: none"> a. Element connecting pipe seal gets damaged; b. Permeate port seal gets damaged; c. Adaptor seal gets damaged. 	<ul style="list-style-type: none"> a. Replace element connecting pipe seal; b. Replace permeate port seal; c. Replace adaptor seal.
3. The adaptor cracks during installation	<ul style="list-style-type: none"> a. Installation sequence is not correct; b. The installation is not performed following procedure, 	<ul style="list-style-type: none"> a. Insert the adaptor into the element first, then install the head assembly; b. For correct procedures, see Section 4. 3.4.2;
4. The retaining ring can not be removed after being used for some time	<ul style="list-style-type: none"> a. The retaining ring is seriously deformed after being used for a long time. 	<ul style="list-style-type: none"> a. Try soaking with a mold release agent or rust remover in the connecting area of the retaining ring and hit slightly with handle of a screwdriver or other tools so as to hit it off.
5. The head can not be removed after being used for some time.	<ul style="list-style-type: none"> a. The head seal gets deformed and corroded seriously. 	<ul style="list-style-type: none"> a. Remove permeate port pure water pipe connecting head. Insert an iron rod (o.d.=20) into the permeate port water outlet pipe for about 150 mm and tap the rod back and forth slightly (take care not to hit the element) until the head is removed. b. You can also use a head puller tool to remove the head.

SECTION 8. Membrane Housing Assembly Drawing

- 1 Retaining ring
- 2 Bearing plate
- 3 Head seal
- 4 Permeate port
- 5 Permeate port seal
- 6 Adaptor
- 7 Adaptor O ring
- 8 Thrust cone
- 9 Shell
- 10 End port
- 11 End port seal

