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16" BEL Vessels

1 - General

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1.1 Introduction

High Performance Composite Pressure Vessels for Reverse Osmosis (RO), Nano-filtration (NF) and Ultra-filtration (UF) Membrane Applications

BEL™, founded in 1966, specialize in designing and manufacturing variety of products made from advanced composite materials. With over 40 years of experience, the company has developed and mastered the innovative technologies necessary to manufacture the highest quality composite products. Combining innovation, technology, responsibility and dedication, we are leaders in providing commercial and industrial composite vessels for our clients needs.

BEL™ 16S pressure vessels are manufactured from filament wound Fiber Reinforced Plastic (FRP), wound over precise Chrome coated mandrels, using a superior epoxy resin, which results in the ultimate combination of physical strength, long lasting life time and an ultra smooth inside surface. Each vessel is designed and tested according to the engineering requirements of the latest version of the American Society of Mechanical Engineering (ASME) code for Boiler and pressure vessels section X for Fiber-Reinforced Plastic pressure vessels, the internationally recognized standard for pressure vessel construction.

BEL™ 16S vessels are designed to stand with pressure more than 6 times from the design pressure and 100,000 cycles of working pressure. All **BEL™**'s vessels are hydro tested in 1.1 from working pressure to insure all the restricted qualification rules of **BEL™**.

The pressure vessels are manufactured in different configurations, from 1 to 8 40 inch membranes according to the required operating pressures, filtration type, and piping layout. In order to enhance interchangeability and facilitate the use and maintenance of the vessels, the utilization of identical parts and sub-assemblies has been maximized throughout the design of the vessel. For better performance and longer service life, each model is manufactured from the best quality for materials of construction.

BEL™ holds ISO 9001 quality systems certification, and its quality assurance is also approved for in-house final inspection by many of its customers.

1.2 Versions and Revisions

1.2.01. Version 1.0.

Original publication - Revision A 01 April 2011

1.3 - How to Use This Manual

1.3.1 - Chapter List

The chapters of this manual are listed in the overall TABLE OF CONTENTS.

1.3.2 - Chapter contents

Each chapter includes a detailed internal Table of Contents.

1.3.3 - Page numbers

All page numbers consist of two sets of digits. The digits indicate the page number within the chapter and the total number of pages in the chapter. The page numbers can be found on the bottom right side of each page.

1.3.4 - Revision

The last revision and the corresponding date are printed at the bottom of each page. An updating lists in chapter 1 (General) lists the revision dates and the revision number.

1.3.5 - Safety

BEL pressure vessels are designed for high-pressure operation. Improper installation, operation, service or maintenance may cause severe damage to property, physical injury or death.

Carefully read and understand all the instructions detailed in this guide and especially the safety instructions in section 1.5 before installing, operating, disassembling, assembling or servicing the vessel.

1.3.6 - Warnings, Cautions and Notes

Throughout the manual the following type sets and/or instructions are used to identify information of a particular importance:

****WARNING**

A paragraph or subsection heading in underlined bold type, with double asterisks indicates the presence of a hazard, which may cause severe damage to property and/or physical injury or death.

***CAUTION**

A paragraph or subsection heading in underlined bold type, with a single asterisk, indicates the presence of a hazard, which may cause damage to components of your equipment.

The following table lists the vessels available from **BEL**. All vessels are designed and manufactured to be compatible with the full range of operating pressures and mounting configurations:

16" diameter vessels	Intended use
BEL16-E-300 BEL16-S- 300	Low-pressure vessel. For use with operating pressures of up to 150 & 300 psi.(10 & 21bar)
BEL16-E-450 BEL16-S-450	Low-pressure vessel. For use with operating pressures of up to 450 psi.(31 bar)
BEL16-E-600 BEL16-S-600	Medium-pressure vessel. For use with operating pressures of up to 600 psi.(41bar)
BEL16-E-1000 BEL16-E-1200 BEL16-S-1000 BEL16-S-1200	High-pressure vessel. For use with operating pressures of up to 1000, 1200 and 1500 psi. (69, 87 & 102 bar)

Legend:

E...End Port, S...Side Port

Each model is available in different lengths in accordance with the required number of elements 1 to 8 elements of 40" membrane for 16" vessels.

BEL pressure vessels are designed to comply with the engineering standards of the Boiler and Vessel Code Section X of the American Society of Mechanical Engineers, the ASME Code. Vessels built to the ASME code are accepted as being built to the highest safety and quality standards.

Vessels are built to pass the rigorous and strict ASME Code qualification tests, which require a safety coefficient of 6 (i.e., the vessel must withstand a pressure of at least 6 times the vessel's rated operating pressure). Additionally, each **BEL** pressure vessel is pressure tested at 110% of its maximum operating pressure before leaving our plant to insure high quality control.

1.4 Operation and Maintenance Guide

1.4.1. Proper vessel installation, operation, handling and maintenance, in strict accordance with the Guidelines and instructions presented in this guide are crucial to the vessels' safety and long service life.

1.4.2. Strictly follow the installation and maintenance instructions detailed in this guide. However, take into consideration that this guide serves to provide safe instructions and procedures. It does not relieve the user/buyer from any obligation or responsibility related to the installation, inspection and maintenance procedures, which must all be carried out at the highest professional level and in accordance with good industrial and engineering practices.

1.4.3. Carefully read **all** of the instructions. Improper installation, inappropriate operation or corrosion damage may cause mechanical failure, damage to property, injury or death.

1.4.4. Strictly follow all safety precautions and safety instructions before conducting any service or maintenance. Failure to comply with the above might result in damage to property, physical injury or death.

1.5 ****DANGER - HIGH PRESSURE**

1.5.1. BEL pressure vessels are designed for high-pressure operation. Improper installation, operation, service or maintenance may cause severe damage to property, physical injury or death.

1.5.2. BEL pressure vessels are designed for water treatment use only.

1.5.3. Do not use with compressed air.

1.5.4. 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 alternatives may be available.

1.5.5. PRESSURE AND TEMPERATURE DESIGN LIMITS – Operation of a vessel outside of design limits will make void the warranty and could result in vessel fatigue with possible eventual explosive head failure. Although each vessel is tested to 1.1 times the 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 120oF. (49°C)

1.5.6. PROTECTION FROM OVER-PRESSURIZATION – It is essential that protection against Over-pressurization of the vessel will be provided such that the pressure to which any vessel is subjected cannot exceed 105% of design pressure.

1.5.7. 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.

1.5.8. ACCESSIBILITY – Pressure vessels should be positioned within the system such that membrane 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).

1.5.9. Carefully read and understand **all** the instructions detailed in this guide before installing, operating, disassembling, assembling or servicing the vessel.

1.5.10. Failure to comply with safety precautions related to installation, service, maintenance or any other relevant aspect might result in system failure, property damage, injury or death.

1.5.11. Misuse of vessels, improper assembly, or the use of damaged or faulty parts may result in the bursting of the vessel and the release of the head assemblies.

1.5.12. Only qualified mechanics, experienced in working with and servicing high-pressure hydraulic systems, should be allowed to disassemble or assemble the vessel.

1.5.13. **DO

1.5.13.1. Read and fully understand all the safety precautions and procedures detailed in this guide. Failure to comply with the safety precautions or Standard Operating Procedures (SOPs) may result in severe damage, injury or death.

1.5.13.2. Install the vessel in strict accordance with the manufacturer's instructions. Be sure not to install the vessel in locations where water leakage (due to a possible vessel or pipe malfunction) may cause damage.

1.5.13.3. Make sure that all head-locking components are properly installed and secured.

1.5.13.4. Regularly inspect the system so as to ensure that the various components have not deteriorated or been damaged. Replace any faulty component; make sure the reason for the fault has been found and fixed as well!

1.5.13.5. Make sure that vessels and associated pipe systems are fully depressurized before attempting any service or maintenance operation.

1.5.13.6. Strictly follow the instructions and recommendations issued by the manufacturer of the membranes concerning the installation of the RO/NF/UF membrane elements in the vessels.

1.5.14. **Do Not

1.5.14.1. Do not extract or disassemble any component until you have verified that the vessel is fully relieved from pressure.

1.5.14.2. Do not operate the vessel under pressures and temperatures exceeding the rated operating values, as noted in the product specifications and as indicated on the vessel.

1.5.14.3. Do not over-tighten the vessel straps, as this could prevent the vessels from expanding freely.

1.5.14.4. Do not pressurize a vessel until you have made sure that all parts are properly assembled and secured.

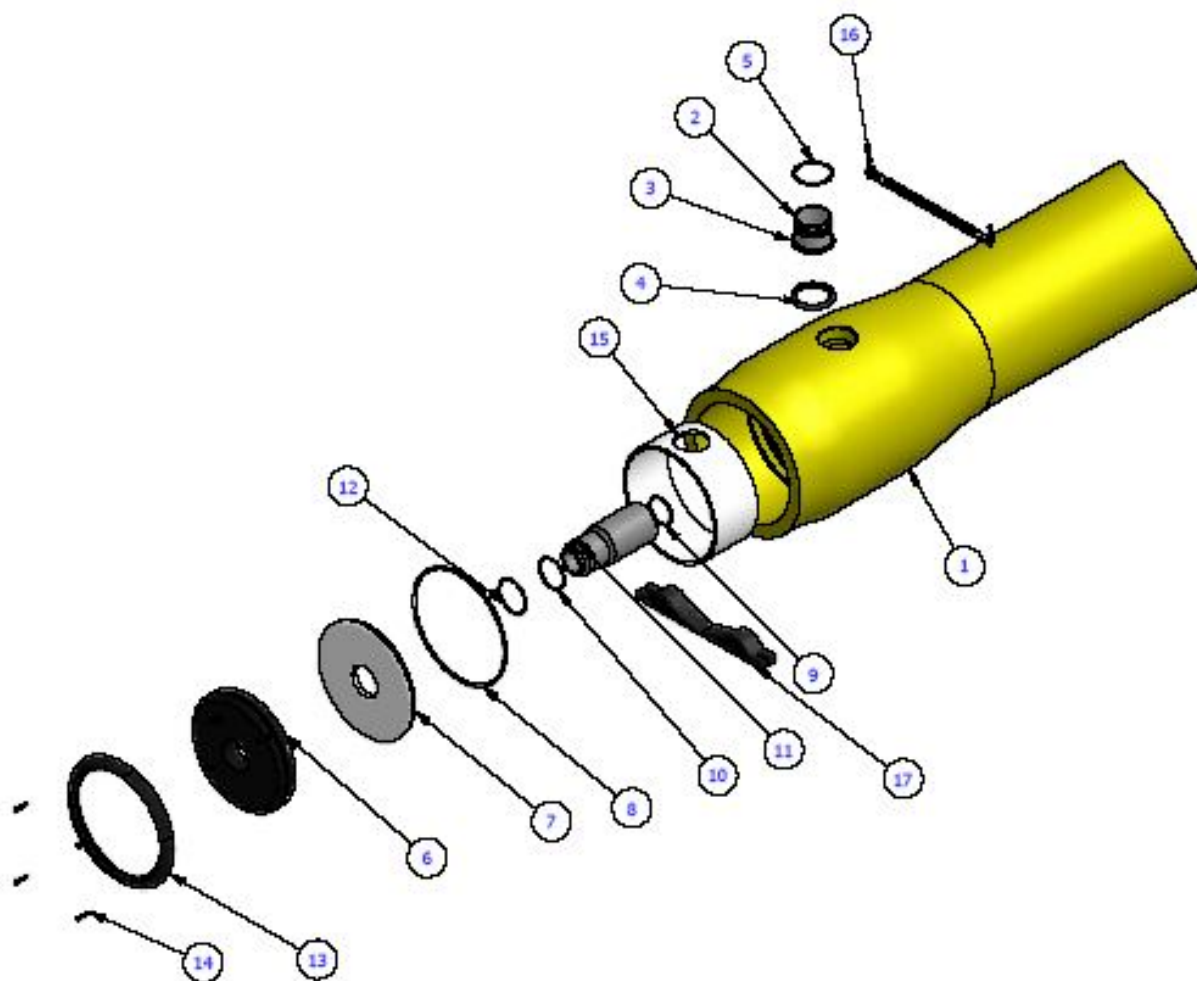
1.5.14.5. Do not allow petroleum or silicone based chemicals to contact membrane parts during installation or operation.

1.5.14.6. Do not use excessive quantities of silicone lubricants.

1.5.14.7. Do not apply forces exceeding 5 kg on end fittings protruding from the vessel.

1.5.14.8. Do not use faulty components (worn, distorted, deeply corroded, etc.). Using such faulty components may result in system failure and the bursting of the vessels' end fittings.

1.5.14.9. Do not climb or stand on top of a vessel or any other part of the system.



PART LIST		
ITEM	QTY	PART DESCRIPTION
1	1	Pressure Vessel BEL 16-S
2	1-4	Side Port 4"-6"
3	1-4	Disk For Side Port
4	1-4	Seal For Side Port
5	1-4	Retaining Ring For Side Port
6	2	Base Plate
7	2	Sealing Plate
8	2	Seal For Sealing Plate
9	2	Seal For Adapter
10	2	Seal For Permeate Port
11	2	Permeate Port
12	2	Retaining Ring For Permeate Port
13	2	Support Ring
14	8	DIN 912-M8 x 45
15	1	Thrust Ring & Locator
16	2-3	Straps
17	2-3	Saddles

1.6 Installation

1.6.1. **Warning

This is a high-pressure system; all parts must be properly installed in order to assure safety and service life. Even if the system was installed by others, you still have to perform several critical checks, described in paragraph 1.7, before operation.

1.6.2. General guidelines

1.6.2.1. Make sure that the vessel is horizontally installed on support saddles made of black urethane, with its drain hole facing down.

1.6.2.2. The vessels must not be rigidly clamped in place, which would prevent lateral and longitudinal expansion.

1.6.2.3. Pipes must be connected to ports using flexible connectors to allow relative movement of the vessels and piping. We recommend using Victaulic® or equivalent connections.

1.6.2.4. Make sure that vessels do not support any other part of the system.

1.6.3. **Warning

Over-tightening the vessel's shell straps prevents the vessel from expanding laterally and longitudinally, which may result in damage to the vessel.

1.6.3.1. Mounting design must allow for both axial and radial vessel expansion. Although the expansion under pressure is slight, restriction can result in damage to the vessel and to other system components. Expansion is typically up to 0.5mm in diameter and up to 2-3mm in length for an eight element vessel. The following suggestions will help ensure that the vessel can expand and will also ease servicing.

1.6.3.2. Mount the vessel on the support pads furnished. Do not mount the vessel directly on to any rigid structure.

1.6.3.3. Use the straps supplied. Straps should be tightened enough to hold the vessel onto the support pads, but never so tightly as to restrict expansion.

1.6.3.4. U-bolts should not be used in mounting under any circumstances.

1.6.3.5. A flexible piping connection should be provided 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.

1.6.3.6. Do not hard-plumb any piping to the vessel.

1.6.3.7. Support the header independently. Piping should be self-supporting or supported by the headers.

1.6.3.8. Include an expansion loop in the branch connection to allow for elastic growth under pressure and thermal growth in length.

1.6.3.9. The total weight of the branch connection and fittings supported by the vessel should not exceed 5 kg for either the feed/concentrate ports or the permeate port.

1.6.3.10. The above suggestions are meant to help prevent damage in typical systems. Unusual or custom systems may involve other considerations, to be determined by the system designer.

**For any other question related to the installation of system components please contact BEL by
E-mail: composite@bel-g.com**

1.7 Critical Pre-operation Checks

1.7.1. General

1.7.1.1. BEL pressure vessels are designed for high-pressure operation: improper installation, operation, service or maintenance may cause damage to property, physical injury or death.

1.7.1.2. Carefully read and understand **all** of the instructions detailed in this guide and especially the safety instructions in section 1.5 before installing, operating, disassembling, assembling or servicing the vessel.

1.7.1.3. Failure to comply with safety precautions related to installation, service, maintenance or any other relevant aspect might result in system failure, property damage, injury or death.

1.7.1.4. Misuse of the vessels, improper assembly, or the use of damaged or faulty components may result in bursting and the release of the vessel's end assemblies.

1.7.1.5. Only qualified mechanics experienced in working with and servicing high-pressure hydraulic systems should be allowed to disassemble or assemble the vessel.

1.7.1.6. Before you pressurize the vessel, perform the following checks to ensure that the system is ready.

1.7.2. Membrane elements

1.7.2.1. Membrane installation must be carried out in strict accordance with the instructions issued by each membrane supplier.

1.7.2.2. Particular attention should be paid to correct membrane flow direction and installation.

1.7.3. The inner components of the vessel

1.7.3.1. Adapters must be installed on both ends of the element column.

1.7.3.2. A thrust ring must be installed at the downstream end of the membrane column.

1.7.3.3 The length of the thrust rings must coincide with the adapter so that both of them will support the thrust resulting from the membrane operation.

1.7.4. Head

1.7.4.1. All components must be in an “as-new” condition, clean and free from damage or corrosion, before installation.

1.7.4.2. All components must be properly assembled with new seals which are lubricated with the appropriate lubricant.

1.7.4.3. All ports must be in the correct position and orientation.

1.7.4.4. All retaining rings and lockers must be properly installed.

1.7.5. Head assembly interlock

1.7.5.1. Locking grooves on both ends of the vessel must be clean and free of corrosion or delamination. The groove-face must be in good condition (straight, fully intact and smooth).

1.7.5.2. All components must be clean, in an “as new” condition and free of any sign of damage or corrosion.

1.7.5.3. The segments of the support ring must be properly installed and held in place in the locking groove by means of the appropriate securing screws provided by **BEL**.

1.7.6. Piping connections

1.7.6.1. Pipes must be correctly positioned with well-tightened Victaulic® connectors.

1.7.6.2. All connections must be dry and leak-free.

1.7.7. Pre-pressurizing

1.7.7.1. See chapter 2, section 2.5.

1.8 Use and care of O-rings.

1.8.1. Lubricants for the installation of seals

1.8.1.1. In order to prevent damage, to ensure easy installation and to improve sealing abilities, all seals must be lubricated with an appropriate lubricant prior to installation.

1.8.1.2. Seal lubrication makes it easier to introduce the seal safely to its place and assures better sealing.

1.8.1.3. **BEL** recommends that only Glycerin or the Parker-Super-O-Lube™ be used as lubricants. To prevent seal contamination by dust or other particles, lubricants should only be applied just before seal installation.

1.8.1.4. Assembly lubricants should always be used sparingly during application: a light film is all that is required. Parker-Super-O-Lube™ when used sparingly will not foul the membranes (Parker-Super-O-Lube™ is pure, high viscosity silicone oil and since there are no fillers in it there can be no clogging of micro-filters and membranes).

1.8.2. *Caution

When used sparingly to pre-lubricate the seal, glycerin may ease the re-assembly process and enhance performance. Glycerin will not foul the membrane elements.

However, when used appropriately, Parker-Super-O-Lube™ (a silicone-based seal lubricant) is preferred and will ease installation.

1.8.3. *Caution

Seals should be lubricated each time the head is assembled. Use lubricant sparingly, as excessive lubrication may foul the membrane elements.

1.8.4. Cleanliness

1.8.4.1. Keeping all parts super clean is important for proper seal action and long O-ring life. Take every precaution to make sure that all parts are clean during assembly. Any foreign particle - dust, dirt, chips, grit, etc. - in the gland may cause leakage, damage the O-ring and shorten its service life.

1.8.5. Assembly

1.8.5.1. O-ring assembly must be carried out with care to ensure that the O-ring is properly placed in the groove and that it is not damaged as the gland is closed or as it is pushed to its sealing face.

The following are general assembly instructions:

1.8.5.1.1. O-rings should not be twisted. A twist during installation is likely to occur with O-rings having a large I.D./cross section diameter ratio, Take extra care.

1.8.5.1.2. O-rings should never be forced over sharp corners, threads, keyways, slots, curved surfaces, ports or any other type of sharp edge. If sharp edges cannot be avoided because of port design, then thimbles, supports or other shielding arrangements must be applied.

1.8.5.1.3. The O-ring must not be pinched at the groove corners during gland closure or O-ring placement.

1.8.5.1.4. Gland closure should be accomplished by straight, longitudinal movement. Rotary or oscillatory motion is forbidden since it may cause bunching, cutting or damage to the seal.

2 Maintenance

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2.1. Opening the Vessel.

2.1.01. – General comments and instructions

2.1.01.01 - Before you open any vessel, carefully read and understands the instructions, precautions and guidelines in this section. Failure to do so may result in damage to property or equipment, physical injury or death.

Some instructions concerning 16" vessels are generally applicable to both end and side port vessels.

Any comments which are only applicable to one of the two types is indicated as being applicable to a particular type of vessel.

2.1.01.02. - **Warning

Never attempt to work on any system component until you have verified that the pressure is fully relieved from the vessel.

Attempting to remove any component before pressure is fully relieved may result in the explosive release of the head.

2.1.01.03. - *Caution

Corroded parts may cause difficulties in removing the head or other components. Do not try to remove components before all visible signs of corrosion have been eliminated.

Failure to comply with these instructions may result in damage to the head and/or vessel components as well as personal injury to the operator.

2.1.01.04. - Relieving Pressure

Stop all pumps and relieve pressure according any manufacturers or other instructions.

2.1.01.05. - Disconnect Ports

Disconnect all pipes from ports connecting the vessel's heads with the manifolds.

2.1.01.06. - Visual inspection of vessel heads

Once heads have been disassembled perform a visual inspection of the vessel head and fittings, to locate any sign of corrosion. If corrosion is found, follow the following steps:

2.1.01.06.01. - Use a small wire brush to loosen any large deposits.

2.1.01.06.02. - Place components (seals excluded) in a shallow container of soapy water and scrub their surfaces with Medium-grade scrubbing paper or equivalent until all corrosion is removed.

2.1.01.06.03. – Clean the components with clean water.

2.1.01.06.04. - Blow components dry with compressed air, if available.

2.1.01.06.05. - Examine components for damage that could affect structural strength or sealing properties. Any components not in an as-new condition must be replaced.

2.1.01.06.06. - Inspect components for any condition that may have promoted corrosion (e.g. scratched anodizing).

2.1.01.07. – Note / *End port vessels only*

Before removing the head on end port vessels, index marks should be made on the vessel shell, indicating the port's original relative position (in order to facilitate alignment during re-assembly). Piping should be disconnected as close to the vessel's ports as possible, as this will make head handling more convenient on front port vessels.

2.01.02. - Head Disassemble for All 16” models

2.01.02.01. - Use M8 socket head Allen key tool for opening all the screws from the locking device.

2.01.02.02. - Remove all the locking devices from the groove using a screw driver or any other suitable tool which will not damage the vessel or the Base Plate (if the locking segment is jammed tap on the base plate with a plastic hammer).

2.01.02.03. – Tight the Puller's legs to the vessels wall as shown in *figure 1*, for supporting the Puller to the vessel.

2.01.02.04. – Connect the profile by placing the handle's holes concentric to the base plate's holes and screw in the bolts (see *figure 1*).

2.01.02.05. – screw out the handle counterclockwise to extract the Head assembly, after that pull out the Puller and the head carefully.

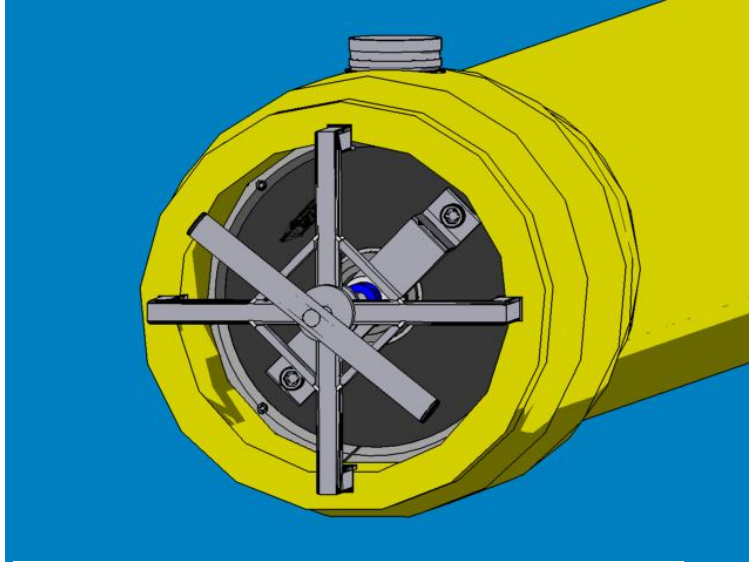


Figure 1: Puller for 16" head assembly

Warning!!

To avoid personal injury, be careful not to drop the tool while extracting.

2.1.03.02 - Note

If the vessel has been in service for a long time, the head may be “frozen” in its place and more difficult to remove.

2.1.03.04 - Note

Removal of a “frozen” head may be assisted by a slight rocking effect or slight tapping with an appropriate wooden tool.

2.1.03.05 - *Caution

Do not tap forcefully on the side of the head as this may cause the head disk to tilt and eventually damage the shell.

2.2 Replacing Membrane Elements

2.2.01. - **Warning

Carefully read and understand the complete following chapter before you starts applying the procedure.

The instruction below doesn't cancel the manufactures instructions.

Failure to comply with the above may result in damage to property and equipment, physical injury or death.

2.2.02. - **Warning

Never attempt to work on any system component until you have verified that pressure is fully relieved from the vessel.

2.2.03. - **Warning

Never connect the vessel to a pressure source if the vessel is not fully and properly assembled. Pressurizing a vessel which is not fitted with all necessary elements, membranes and adapters may result in the bursting of the vessels' end components.

2.2.04. - Preliminary steps

2.2.04.01. - Depressurize the vessel, following the instructions supplied by the manufacturer of the filtration unit

2.2.04.02. - Remove the two heads. See "Opening the Vessel", section 2.1.

2.2.05. - Removing inner components

2.2.05.01. - Remove thrust ring from the downstream end.

2.2.05.02. - Remove the membrane adapters from the membrane elements at each end.

2.2.06. - Removing the membrane elements

2.2.06.01. - *Caution

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

2.2.06.02. - Note

Always remove membrane elements in the direction of feed flow, taking them from the downstream end. The feed end is generally, but not always, the one closest to the feed pump. Flushing the vessel with fresh water or with a 50/50 glycerin/water solution may facilitate element installation/removal.

Use a small amount of lubricant to lubricate seals. Excessive lubrication may contaminate the membrane element.

2.2.06.03. - Elements must always be removed in the feed flow direction. Clean any excess lubricant from the vessel bore before removing the elements also clean all vessels' surface from membrane to edge of the vessel. Remove the membrane element from the vessel following membrane manufacturer's Instructions.

2.2.07. - Loading the membrane element

2.2.07.01. - Examine the inside surface of the vessel for scratches or imperfections which may impair the sealing capability of heads or membrane element seals. Corrosion or lubricant deposits or other foreign materials should be removed and cleaned as described in the chapter "Closing the Pressure Vessel".

2.2.07.02. - Flush the vessel with fresh water to remove dust and debris.

2.2.07.05. - Insert the head assembly into the downstream end of the vessel, without the seal for sealing plate, according to section 2.3 "Closing the Pressure Vessel".

2.2.07.06. - Install the segments of the support ring into the locking groove.

2.2.07.07. - Inspect the membrane element surface to find any imperfections that could scratch the vessel bore during element loading. If a defect is found, which cannot be easily corrected, contact the element manufacturer.

2.2.07.08. - Use a 50/50 solution of water/glycerin to lubricate the inside of the vessel. The best way to do this is by using a swab soaked in the solution. This will assist membrane element loading and reduce the risk of inadvertently scratching the vessel bore.

2.2.07.09. - Note

If the brine seal is not installed on the membrane element and unless otherwise instructed by the manufacturer, install a brine seal on the upstream end of the element/s. The seal's open side should face upstream.

2.2.07.10. - Load the first element into the upstream end of the vessel. Leave about 10 cm of the element projecting out of the vessel to facilitate connection with the next element.

2.2.07.11. - Apply a small amount of Super O-Lube™ onto the O-ring on the interconnector. The lubricant should be used sparingly, just enough to give a luster to the O-ring. Excess lubricant must be cleaned and removed to prevent possible contamination of the element.

2.2.07.12. - Connect the interconnector to the projected end of the loaded element.

2.2.07.13. - *Caution

Carefully maintain element alignment during assembly. Do not allow the weight of the element to be supported by the interconnector.

2.2.07.14. - *Caution

Misalignment may result in damage to the interconnectors, to the permeate tubes, to the Adapters or to the outer surface of the elements and the vessel.

2.2.07.15. - Line up the next element and assemble it to the interconnector which is already on the first element.

2.2.07.16. - Carefully push the two elements into the vessel until the second element is projecting from the vessel about 10 cm. Repeat the above steps until all elements have been assembled.

2.2.07.18. - Remove the downstream head assembly and re-assemble it with the seal for sealing plate, as described in the section 2.3 "Closing the Pressure Vessel".

2.2.08. - Installing element interface hardware

2.2.08.01. - Assemble an adapter to the permeate tube at each end of the vessel. Use PVC shimming discs to align adapters and thrust rings faces.

2.2.08.02. - **Warning

Use an adapter to connect the element column's permeate tube to the permeate ports on both ends of the vessel.

Pressurizing the vessel without having installed both adapters may result in severe system failure.

2.2.08.03. - Install the thrust ring on the downstream end of the vessel.

2.2.08.04. - *Caution

Make sure you install the thrust ring on the downstream end of the vessel. A thrust ring installed on the wrong side may result in catastrophic system failure.

2.3. Closing the Pressure Vessel

2.3.01. - **Warning

Carefully read and understand the complete following instructions before you start applying the following procedure. Failure to comply with the above may result in damage to property and equipment, physical injury or death.

2.3.02. - **Warning

Inspect the head assembly for any sign of corrosion, as described in the section “Head Re-assembly”. Corroded parts may cause severe damage and vessel failure. Never pressurize a vessel until you have visually inspected that the locking device is in place and correctly secured.

2.3.03. - Preliminary Steps

Do not proceed until:

2.3.03.01. - All membrane elements and adapters have been assembled and loaded into the vessel as described in the section “Replacing membrane Element”, paragraph 2.2.08.

2.3.03.02. - Both heads have been thoroughly inspected to make sure that all the parts have been properly assembled, as described in the section “Head Re-assembly”.

2.3.03.03. - The vessel’s upstream adapter (also called end connector) has to be shimmed with PVC disks to prevent the elements from moving. Go through all the steps below according to the procedure:

2.3.03.03.01. - Clean the sealing area with a rag; make sure that no left-over of the vessel is left.

2.3.03.03.02. – Head assembly at the feed side must be shimmed in order to keep minimum membrane movement during operation and flushing time (see *figure 2*).

Correct shimming can be achieved by calculating the distance between the end of the groove with suited locker to the membrane after pushing the membranes inside (call it X) and assembled head (call it Y), which will bring you to the nominal shimming dimension for knowing the fixed dimension of head assembly with the permeate port:

$X - Y - 2 = \text{shimming dimension needed [mm]}$.

2.3.03.03.03. - After the shimming look at the small O-ring at the adapter and make sure it's not damaged.

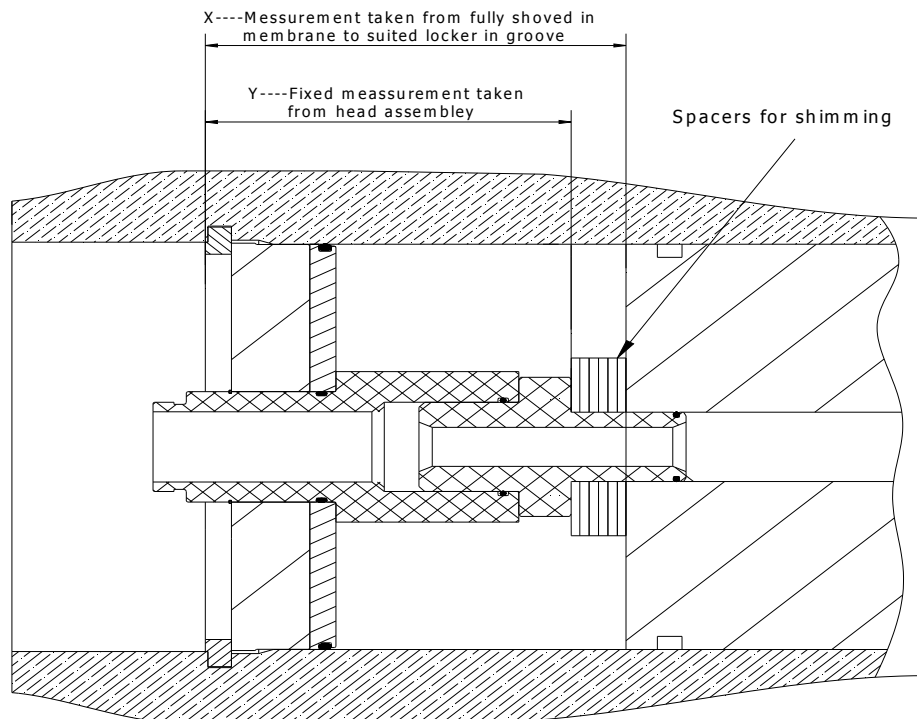


Figure2: Shimming for head assembly

2.3.04. - Inspection of the vessel's internal surface

2.3.04.01. - Closely inspect the vessel's internal surface to detect any accumulation of corrosion deposits or other foreign materials. In case any deposit of foreign material has been discovered, clean the surface as follows:

2.3.04.02. - Use only fine sandpaper or equivalent to scrub and a mild detergent solution to carefully clean both ends of the vessel, up to 20 cm into the vessel.

2.3.04.03. - Thoroughly flush all the deposits from the inside of the vessel.

2.3.04.04. - Use a small screwdriver, a thick wire or a thin rod to remove deposits or debris from the drain hole.

2.3.04.05. - Inspect the inside surface of the vessel to find scratches or other imperfections which may cause leaks. Leaking vessels cannot be repaired and must be replaced.

2.3.05. - **Warning

Never attempt to repair the fiberglass vessel. Never attempt to repair or disassemble the feed/concentrate port in a side port vessel without consulting BEL Failure to comply with the above may result in catastrophic damage, physical injury or death.

Please consult BEL for additional information concerning replacement of side ports or side port seals.

2.3.06. - Head seal lubrication

2.3.06.01. - Apply a thin layer of Parker-Super-O-Lube™ inside the vessel ends, where the main head-seal is installed. Apply the lubricant from a point halfway up the bevel to a point approximately 15 mm from the bevel's upper end (covering approximately 1 cm beyond the installed seal's final position).

2.3.06.02. - Make sure that the entire head seal is covered with a thin layer of seal lubricant. The lubricant and the ring must be free of dirt or dust.

2.3.06.03. - Note

Seal lubrication may be performed with standard commercial glycerin which does not contaminate the membrane elements.

2.3.06.04. – Note

Before applying fresh lubricant, be sure to clean and remove old or excessive lubricant.

2.3.07. - Head re-assembly

2.3.07.01. -Note

In some installations it may be advisable to assemble the nipple or the fitting to the permeate port before assembling the head to the vessel.

2.3.07.02. - Warning

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

Over-tightening may damage the permeate port.

2.3.07.03. –Align any index marks that you have made on head assembly and on the vessel body. This will ensure the correct alignment of port connections on front port vessels. Do not rotate head assembly after insertion into vessel as this may cause the head seal to leak.

2.3.07.04. - Hold the head assembly square to the axis of the shell and slide it straight in until resistance is felt.

2.3.07.05. – Use the pusher in order to create thrust force that will shove in the head assembly into the bore. Push the head as far as it will go (you may need to apply more force at first, in order to insert the main seal into the vessel bore). Once the head is in the correct position, the support ring groove is exposed.

2.3.07.06. - *Caution

If the head is allowed to rock from side to side during installation, the main head seal may become detached and lose its sealing ability.

2.3.08. - Installing the locking device

2.3.08.01. - **Warning

All the support ring components must be properly installed. Failure to comply with this instruction may result in severe damage to property and/or physical injury or death.

2.3.08.02. -All 16” vessels

2.3.08.02.01 - With the head assembly inserted into the shell, slide the four segments into the locking groove and screw in the bolts.

2.3.08.02.02 - Visually inspect how the support ring installed to ensure its position is correct, between the Base-plate and the vessel groove. Make sure that the bolts appropriately tighten to the Base-plate.

2.3.08.02.03. - Note:

Do not over tighten the bolts. Turn the bolt counterclockwise one turn after getting to the full length of the bolt.

2.4. – Reconnecting End Ports

2.4.01. - Note

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

2.4.02. - Reconnect manifolds to the vessel ports.

2.4.03. - **Warning

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

Over-tightening may damage the permeate port.

2.5. - Pre-pressurization Inspections

2.5.01. - The checklist is an aid intended to remind service and operating personnel of the guidelines given in this Technical Manual. It does not include all the details needed for safe vessel pressurization. Use the checklist each time any service operation is carried out so as to ensure that each step is completed before pressurizing the vessel.

2.5.02. - **Warning

Never pressurize a vessel until a final check and inspection was made, assuring that all components have been properly assembled and that the vessel is ready for safe operation.

Before attempting to pressurize a vessel, run the following checks and inspections.

2.5.03. - Head Assembly

2.5.03.01. - the head assembly is in good condition, free of any signs of damage or corrosion (See appropriate Head-assembly chapter).

2.5.03.02. - the locking device is in place and well secured. See Head Assembly, paragraph 2.3 “Installing the locking device”.

2.5.04. – Piping

2.5.04.01. - Inspect all piping and pipe connections to ensure the connection quality and locate possible leaks.

2.5.05. - PRE-PRESSURIZATION CHECKLIST

(We suggest that you print off copies of this page, and use them by checking off the different actions as assembly is carried out and checked)

2.5.05.01. - MEMBRANE ELEMENTS

- ☐ - installed per manufacturer's recommendations
- ☐ - Feed flow direction correctly noted and elements correctly oriented.

2.5.05.02. - ELEMENT INTERFACE

- ☐ - Adapters installed at both ends of element column.
- ☐ - Thrust ring installed downstream of the element column, indexed correctly around the brine ports on side port vessels.

2.5.05.03. - HEAD

- ☐ - All components in as-new condition clean and free of damage or corrosion.
- ☐ - All components properly assembled with new, freshly lubricated seals.
- ☐ - permeate port Retaining ring in place.

2.5.05.04. - HEAD ASSEMBLY INTERLOCK

- ☐ - Locking groove at each end of vessel clean, free of corrosion or delamination.
- ☐ - All components in as-new condition clean and free of damage or corrosion.
- ☐ - all four segments of the locking ring set fully seated and held in place by the screwed bolts.

2.5.05.05. - PIPING CONNECTIONS

- ☐ - Properly aligned (strain free) and secured.
- ☐ - Leak free.

2.6. Pressurizing Pressure Vessels

2.6.01. - **Warning

Never pressurize a vessel that has not been loaded with membrane elements.

2.6.02. - Run all pre-pressurization checks and inspections shown above. Upon successful completion of these checks, pressurize the vessel according to the element manufacturer's specifications.

2.6.03. - Filling of the vessels with fluid should be gradually, to facilitate removal of trapped air.

2.6.04. - Pressurization must be slow and gradual, to prevent damage to membrane elements and other vessel components.

3 Head Assembly for 16” End Port Vessels

Table of Contents

3.1. - General

3.2. - Preliminary actions

3.3. - Head Disassembly

3.4. - Checking and cleaning vessel components

3.5. - Head Re-assembly

3.6. - General Statement of Use

3.7. - Drawings

3.1. – General

3.1.01. - BEL pressure vessels are designed for high-pressure operation: improper installation, operation, service or maintenance may cause severe damage to property, physical injury or death. Carefully read and understand all the instructions detailed in this guide and especially the safety instructions before installing, operating, disassembling, assembling or servicing the vessel.

3.1.02. - Failure to comply with safety precautions related to installation, service, maintenance or any other relevant aspect may result in system failures, property damage, injury or death.

3.1.03. - Misuse of vessels, improper assembly, or the use of damaged or faulty parts may result in bursting and release of the vessels' end assemblies.

It is highly recommended that only qualified mechanics experienced in working with and servicing high-pressure hydraulic systems be allowed to disassemble or assemble the vessel.

3.1.04. - **Warning

Never attempt to work on any system component until you have verified that the pressure is fully relieved from the vessel.

3.1.05. - **Warning

Attempting to remove any component before pressure is fully relieved may result in the explosive release of the head.

3.1.06. - *Caution

Corroded parts may cause difficulties in removing the head or other components. Do not try to force-remove components before all visible signs of corrosion have been eliminated. Failure to comply with this instruction may result in damage to the head and/or vessel components.

3.2. - Preliminary Actions

3.2.01. - Depressurize vessel in accordance with manufacturer's instructions.

3.2.01. - Remove heads as described in the section "Opening the Pressure Vessel", paragraph 2.1.

3.3. - Head Disassembly

Note

See drawing 16s-300/450/600/1000/1200 for component identification.

3.3.01. - Removing the permeate port

3.3.01.01. - **Warning

Always wear safety goggles or use suitable face protection during snap ring removal or installation.

3.3.01.02. - Use snap ring pliers to remove the snap ring which locks the permeate port.

3.3.01.03. - Disassemble the permeate port from the base/seal plate by pressing the threaded end of the permeate port.

3.3.01.04. - Remove the feed/concentrate port

3.3.01.05. - **Warning

Always wear safety goggles or use suitable face protection during snap ring removal or installation.

3.3.01.06. - Use snap ring pliers to remove the retaining ring which locks the feed/concentrate port.

3.3.01.07. - Disassemble the feed/concentrate port from the base plate by pressing the end which projects from the base plate and pulling it from the inner side of the base/seal plate.

Note

The components may be “frozen” in place. You can tap on the ports with a rubber mallet to ease disassembly.

3.3.01.08. - Remove the seals

Note

It is recommended that special tools be used for O-ring removal. If special tools are not available, a small screwdriver or a similar tool may be used. Utmost care should be taken not to damage the sealing plate surfaces, as this may result in leakage.

3.3.01.09. - It is recommended that all seals be replaced every time the head is reassembled.

3.3.01.10. - Carefully remove the O-rings from the base/sealing plate and the O-rings from the permeate port.

3.4. - Cleaning and Inspecting Components

3.4.01. – Cleaning

3.4.01.01 - Flush all head parts with fresh water.

3.4.01.02. - Blow-dry with clean dry air, if available. Alternatively, wipe dry.

3.4.01.03. - Examine the parts for corrosion and/or accumulation of mineral deposits. If any are found, clean as follows:

3.4.01.04. - Use a small wire brush to loosen any large deposits.

3.4.01.05. - Place components in a shallow container of soapy water and scrub their surfaces with Medium-grade ScotchBrite® or equivalent until all corrosion is removed.

3.4.01.06. - Rinse components with clean water.

3.4.01.07. - Blow components dry with compressed air, if available.

3.4.01.08. - Re-examine components for damage that could affect structural strength or sealing properties. Any components not in as-new condition must be replaced.

3.4.01.09. - Inspect components for any condition that may have promoted corrosion (e.g. scratched anodizing).

3.4.02. - Inspection

3.4.02.01. - Examine the surfaces of all items for any damage which might impair the structural strength or sealing properties of the different parts.

3.4.02.02. - Replace any component considered to be imperfect concerning its sealing surface or which is structurally unacceptable:

3.4.02.03. – Base/Sealing plate: discard any cracked or deformed items or any with a damaged sealing surface.

3.4.02.04. - Feed/Concentrate port: discard any bent, distorted, dented or otherwise damaged item, especially concerning the sealing surface or locking arc groove.

3.4.02.05. - Permeate port: discard any material showing stripped or overstrained cross threads, damaged sealing surfaces or damaged snap ring grooves.

3.4.02.06. – Snap ring: discard any bent or distorted items.

Note

Cracked, softened, discolored, corroded or otherwise damaged components may indicate that the component's material might be incompatible with the application. Please consult **BEL**'s Customer Service:

E-mail composite@bel-g.com or your contact person.

3.5. - Head Assembly

3.5.01. - Warning

Base/seal plates must be carefully assembled and installed. Incorrect assembly and/or installation may cause property damage, physical injury or death.

3.5.02. - Caution

When used sparingly to pre-lubricate the seal, glycerin may ease the re-assembly process and enhance performance. Glycerin will not foul the membrane elements.

However, when used appropriately, Parker-Super-O-Lube™ (a silicone based seal lubricant) is preferred and will ease installation.

3.5.03. - Caution

Seals should be lubricated each time the head is assembled. Use lubricant sparingly, as excessive lubrication may foul the membrane elements.

Note

It is highly recommended that all seals be replaced each time the head is reassembled. A seal replacement kit is available from BEL's customer service: E-mail composite@bel-g.com

3.5.04. - Seal lubrication and installation

3.5.04.01 - Apply an even film of seal lubricant to every seal.

3.5.04.02. - Install seals on the base/seal plate and on the permeate port, see installation instructions in the section “Use and care of O-rings”, paragraph 1.8.

3.5.05. - Installing feed/concentrate port

3.5.05.01. - Insert the feed/concentrate port from the inner side of the base/sealing plate and carefully push it in all the way without twisting motion to prevent pinching of the seal.

3.5.05.02. - **Warning

Always wear safety goggles or use suitable face protection during snap ring removal or installation.

3.5.05.02.01. - Use snap ring pliers to install the snap ring which locks the feed/concentrate port into its place.

3.5.06. - Installing the permeate port

6.5.06.01. - Insert the permeate port from the inner side of the base plate and carefully push it in all the way without twisting motion to prevent pinching of the seal.

3.5.06.02. - Warning

Always wear safety goggles or use suitable face protection during snap ring removal or installation.

3.5.06.03. - Use snap ring pliers to install the snap ring which locks the permeate port into its place.

3.5.07. - Installing the heads in the vessel

3.5.07.01. - Install the heads in the vessel, as described in the section “Closing the Pressure Vessel”, paragraph 2.3.

3.6. - General Statement of Use

3.6.01. - Intended use

3.6.01.01. - The vessels are designed, manufactured and tested in accordance with the standards of the American Society of Mechanical Engineers (ASME Vessel Code section X).

3.6.01.02. - The vessels must be installed, operated and maintained in accordance with the precautions listed and with good industrial practice, to ensure safe operation and a long service life.

3.6.01.03. - The vessel must be allowed to expand under pressure; undue restraint at support points or piping connections can cause leaks to develop in the shell. The side-ported vessel requires special precautions in mounting and connection to piping so that the vessel will not be subjected to excessive stress due to bending moments acting at the port.

3.6.01.04. - If a system is restarted frequently without raising the pressure slowly, the movement of the membrane column may damage the O-ring seals. This will reduce permeate quality.

3.6.01.05. - The end closures, incorporating close-fitting, interlocking metal components, must be kept dry and free of corrosion; deterioration can lead to catastrophic mechanical failure of the heads.

3.6.01.06. - BEL Composite Industries Ltd. will assist the buyer in determining the suitability of the standard vessel for their specific operating conditions. The final determination however, including evaluation of the standard materials of construction for compatibility with the specific corrosive environment, shall be the responsibility of the purchaser. Alternate materials with enhanced corrosion resistance are available on special order.

3.6.01.07. - Specifications subject to change without notice.

3.6.02. – Precautions

3.6.02.01. - **DO** read, understand and follow all instructions; failure to take every precaution will void warranty and may result in vessel failure.

3.6.02.02. -**DO** mount shell centered on horizontal members space at recommended span(s) “S”, using compliant mounting hardware furnished; tighten hold-down straps snugly.

3.6.02.03. -**DO** align and center side ports with the manifold header; correct causes of misalignment in a row of vessels connected to the same header.

3.6.02.04. -**DO** use flexible type, grooved-end pipe couplings, Victaulic® Style 75 or equal at side Ports; allow a full .125 inch (3.2mm) gap between port and piping and position piping to maximize flexibility of connection.

3.6.02.05. -**DO** provide flexibility in, and support for piping manifold so that the vessel can grow in length under pressure without undue restraint; provide additional flexible joints in large pipes leading to manifold header.

3.6.02.06. -**DO** provide overpressure protection for vessel set at not more than 105% of design pressure.

3.6.02.07. -**DO** inspect end closures regularly; replace components that have deteriorated and correct causes of corrosion.

3.6.02.08. -**DO NOT** work on any component until first verifying that pressure is relieved from vessel.

3.6.02.09. -**DO NOT** make rigid piping connections to ports, or clamp vessel in any way that restricts expansion of shell dimensions at various pressures and temperatures [$\Delta \text{Dia} = 0.015''$ (0.4mm) and $\Delta L = 0.08\text{-}0.12''$ (2-3mm) for a length 8 membranes].

3.6.02.10. -**DO NOT** hang piping manifolds from ports or use vessel in any way to support other components.

3.6.02.11. -**DO NOT** tighten permeate port connection more than one turn past hand tight.

3.6.02.12. -**DO NOT** operate vessel without connecting both permeate ports internally to a complete set of elements or otherwise plug ports internally, so that external piping connection is not subject to feed pressure.

3.6.02.13. -**DO NOT** operate vessel without thrust ring installed downstream.

3.6.02.14. -**DO NOT** operate vessel at pressures or temperatures in excess of its rating.

3.6.02.15. **-DO NOT** operate vessel with permeate pressure in excess of 125 psi at 120°F (0.9 MPa at 49°C).

3.6.02.16. **-DO NOT** tolerate leaks, or allow end closures to be routinely wetted in any way.

3.7. - Drawings

16" diameter vessels	Drawing number	Revision
BEL16-E-300	16E-300	Rev 0
BEL16-S- 300	16S-300	Rev 0
BEL16-E-450	16E-450	Rev 0
BEL16-S-450	16S -450	Rev 0
BEL16-E-600	16E -600	Rev 0
BEL16-S-600	16S-600	Rev 0
BEL16-E-1000	16E-1000	Rev 0
BEL16-S-1000	16S-1000	Rev 0
BEL16-E-1200	16E-1200	Rev 0
BEL16-S-1200	16S-1200	Rev 0

4. Commercial terms & warranties.

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4.1- Terms and conditions of sale

4.2- Letter of warranty

4.1- Terms and conditions of sale

4.1.01 - General

No contract shall be formed nor shall BEL Group Limited or its subsidiaries (hereinafter referred to as “the Seller”) be obligated to begin production of any order until a purchase order is received in writing bearing an authorized signature of the Buyer. Such signature shall constitute an acceptance of all the herein Terms and Conditions of Sale and these conditions shall be used to supersede all other conditions previously agreed upon by the Seller.

No change in, addition to, or waiver of, the terms, conditions, and specifications contained herein shall be of a binding obligation on the Seller unless approved in writing and signed by an officer of the Seller and shall state that it intended to be effective as such change.

4.1.02 - Acceptance of Orders

All orders and sales contracts are subject to written approval and acceptance by the Seller and are not binding until approved or accepted by the Seller. Any terms and conditions, which are in conflict with these terms and conditions, shall not be binding upon the Seller unless accepted in writing by the Seller. In case of a conflicting terms and conditions not expressly accepted by the Seller, the Terms and Conditions of Sale herein shall prevail and any conflicting terms of Buyer shall be of no force or effect.

Verbal agreements or any writing on this form shall not be binding on either party until reduced to writing and signed in accordance with the terms and conditions contained herein.

4.1.03 - Pricing

Prices quoted are ex-works the Seller's factory and are valid for sixty (60) days unless specifically agreed to in writing otherwise by the Seller. Prices are subject to change without notice, at the Seller's own discretion.

4.1.04 - Payment

Unless otherwise stated, all sales are made on a C.O.D. (cash on delivery) or C.I.A. (cash in advance) basis, at the Seller's option. Accounts will be opened only with companies of individuals whose credit has been approved by the Seller. Open account terms are net cash 30 days. The Seller reserves the right to require partial payment or payment in full in advance even after granting a credit line to the Buyer. Payment shall be made at Seller's general offices.

Invoices not paid within 30 days will be considered delinquent and will accrue finance charges at a rate of 1-1/2 percent per month. The Seller reserves the right to refuse to make shipments to the Buyer as long as an outstanding invoice is delinquent.

Unless otherwise stated in writing, shipments to international companies and individuals will be made either by wire transfer in advance or against an irrevocable and confirmed letter of credit in favor of the Seller with draft drawn at sight and confirmed through Seller's bank. It is the Buyer's option to choose between these two methods.

All payments due to the Seller shall be made net and free of any set-off and/or any deductions and/or withholdings of any nature.

4.1.05 - Taxes, Duties and Clearance Expenses

The Buyer assumes full responsibility including reporting any payment of any and all sales or use taxes, import duties, or other expenses relating to clearance of the goods herein described at destination, or any and all other charges of like nature which may be imposed upon such goods.

4.1.06 - Title

Title to all goods sold hereunder shall pass to the Buyer upon delivery of products ex-works Seller's factory.

4.1.07 - Shipments

All products are appropriately packaged for shipment and the Seller will not be responsible for loss, delay or breakage after having received “in good order” receipts from the carrier. All claims for shortage, breakage, loss, delay and damage should be made promptly to carriers.

In the absence of clear instructions from the Buyer, the Seller reserves the right to ship the goods via a carrier and method deemed to be dependable by the Seller.

Unless otherwise specified, Buyer shall pay all costs of shipping. The Seller’s sole responsibility shall be to deliver the goods to the carrier at Seller’s factory. All shipments are freight collect.

The Seller will make every effort to fill orders within the time promised. Under no circumstances will Seller assume responsibility or liability for any damages to claims resulting from delays in the delivery schedule.

Date of shipment shown on the quotation or Order Acknowledgment form, or promised at any time during the life of the agreement, is based on Seller’s best judgment at that time but may be subject to changing conditions, in many cases beyond Seller’s reasonable control. No liability on Seller’s part shall result in any case.

4.1.08 - Claims

Within thirty (30) days after tender of delivery to or receipt by Buyer of any shipment and before any part of such goods (except for reasonable test and inspection quantities) has been changed from its original conditions, Buyer shall inform Seller in writing if said goods are found defective or short in any respect. Failure to so inform Seller or use of said goods (except for reasonable test and inspection quantities) shall be conclusive that the Buyer is satisfied.

If the goods are found by the Seller to be in unsatisfactory condition and/or defective, then the Seller shall, at its discretion, either:

- (a) replace the non-conforming goods with conforming goods at Seller’s expense; or
- (b) repair the non-conforming goods at Seller’s expense.
- (c) credit the Buyer in the price of the non-conforming goods.

In the event that the goods are found by the Seller to be in a good condition and/or free of defects, then that finding shall be conclusive evidence for all goods that the goods were in such a condition when delivered to the Buyer, and that therefore any defect in the goods could only have arisen or could only have been caused for reasons not connected with the Seller and/or after the delivery of the goods to the Destination.

4.1.09 - Warranty

The sole warranty applicable to goods manufactured or sold by the Seller shall be the standard warranty the Seller. Limited three-year warranty for the vessel body and one year for the head assembly, which is available to the Buyer on request.

This warranty is expressly in lieu of any and all other express or implied warranties with respect to the goods and their components or their installation, use, operation, replacement or repair, including any implied warranty of merchantability or fitness of purpose. Seller shall not be liable by virtue of this warranty or otherwise for any special, incidental, or consequential loss or damage resulting from the use or loss of use of the goods.

4.1.10 - Force Majeure

The Seller shall not be under obligation nor liability for any direct, indirect or consequential damages arising out of delay in performance or nonperformance of the terms caused, directly or indirectly, by fire, explosion, accidents, flood, labor disputes or shortage, war, act of or authorized by any government, inability to obtain suitable material, equipment, fuel, power or transportation, or act of God or arising from contingencies, occurrences or causes beyond the control of the party affected. Quantities so affected by any such circumstances may be discounted without liability, but the terms shall otherwise remain unaffected.

4.1.11 - Cancellation or Order Change Charges

Buyer shall not cancel order nor change specifications, shipping schedules or any other condition except upon written notice and payment to Seller of all reasonable costs incurred as a result of such cancellation or change.

4.1.12 - Returns for Credit

No returns for credit will be accepted unless Seller's permission has been obtained in advance. Credit will be based on prices prevailing at the time of the return, or invoiced price, subject to deduction for handling, restocking and an additional deduction for expenses incurred in restoring goods to saleable condition. The Seller reserves the right to delay payment until another Buyer purchases returned merchandise. Obsolete or specially manufactured goods can be accepted for return or credit only to the extent of value to Seller in each case. No credit will be issued to other than the original Buyer.

4.1.13 - Designs

All designs and specifications shown in Seller's Technical Manual are subject to change without notice. The Seller shall not be under any obligation to continue the manufacture of all or any of the goods and shall be entitled to make such alterations, to the specifications of the products as it may think fit.

4.1.14 - Assignments

Any agreement based upon this Order shall not be assigned by Buyer without the prior written consent of the Seller.

4.1.15 - Governing Law

Any agreement based upon this Order and obligations thereby imposed on Seller and Buyer shall be governed by and construed according to the laws of State where the vessels were produced, and each party hereby submits to the exclusive jurisdiction of the same country courts.

4.1.16 - Waivers

The Seller's waiver of any breach or failure to enforce any of the terms, conditions and specifications of this Order shall not in any way affect, limit or waive the Seller's right thereafter to enforce and compel strict compliance with every item, condition and specification hereof.

4.1.17 - Termination

Any agreement based upon this order may be terminated under the following conditions: (a) the Seller may terminate any agreement based upon this order if the Buyer is prevented from meeting its obligations as they mature, or if any proceedings under bankruptcy or insolvency laws were brought by or against Buyer, or if a receiver for Buyer is appointed or applied for or if an assignment for the benefit of creditors is made by Buyer; (b) in the event Buyer requests Seller to cease work or production once it has commenced or cancels an order or any part thereof, it is understood that cancellation charges will be paid on the following basis: any work which is completed will be paid in full at the quoted price whether shipment is accepted or not; any work in process and any materials or supplies on hand for which commitments have been made is to be paid for on the basis of Seller's total cost plus 35%.

The right to terminate the agreement given by this clause shall be without prejudice to any other right or remedy of the Seller in respect of the breach concerned (if any) or any other breach.

Each order for products shall constitute a separate contract.

4.2 Letter of Warranty

Please refer to *BEL Limited Warranty* files.

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