



**Committed to Quality and Technology**  
Global Leader in FRP Design and Manufacturing

**ROPV**

## Alliances

At ROPV we understand the value of strategic partnership as an essential foundation for success. ROPV consists of co-op alliances between China's top industrial design institutes, universities and laboratories.

## Technical Team

The ROPV technical team is composed of highly knowledgeable and capable team from the FRP Institute specializing in advanced polymer materials, with over 150 combined years of technical and industry experience in composite design and manufacturing.

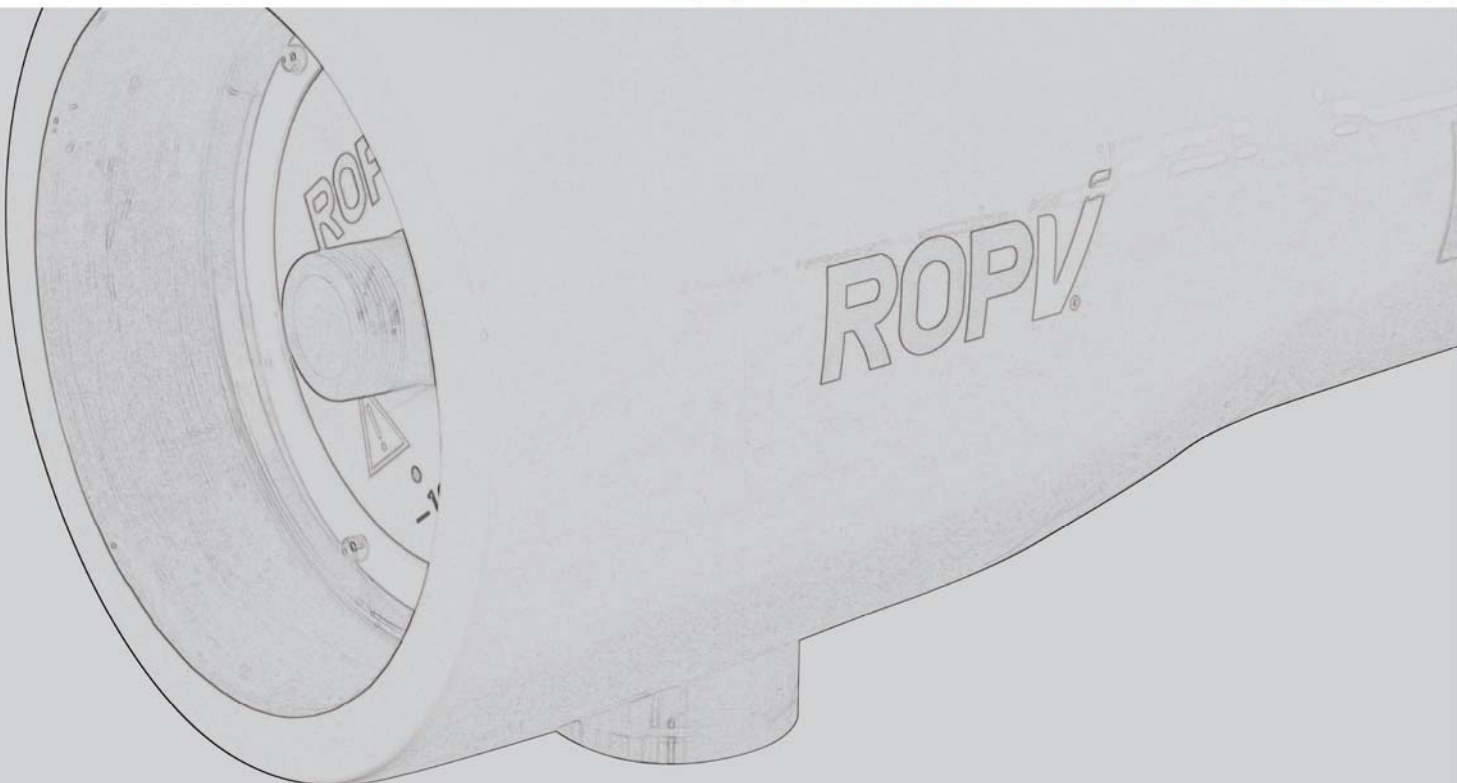
## Integrated Laboratory

The ROPV laboratory is an integrated physical and chemical laboratory equipped with advanced equipment to perform testing and analysis in the areas of:

- Finite Element Analysis
- Resin System Research
- Fatigue Test of Complex Material Compositions



# Research & Development





## Our History

**"ROPV is committed to total quality, innovation and a culture of integrity that establishes successful alliances. Today and tomorrow ROPV is committed to solving the toughest problems of the global water industry."**

It all began in 1984, Harbin ROPV Industry Development Center set out with a single vision—become a global leader in the FRP pressure vessel and water treatment solutions. We focus on innovation and technology to deliver a broad range of water treatment applications worldwide. Over the past 20 years, we've made major strides in realizing our vision and ROPV has emerged as a world class manufacturing company. Our engineering group is composed of members of the prestigious, government sponsored China FRP Design Institute.

Today, we have an established local presence, at the same time ROPV is realizing a broader vision of being a major contributor of water treatment applications technology globally.

We have successfully developed numerous original equipment configurations with various industry partners for UF, EDI, large diameter membranes, and emerging water treatment technologies.

ROPV's headquarters is in Harbin, Heilongjiang Province, China. Our manufacturing facility is located in Dezhou, Shandong Province and positioned with manufacturing capacity to meet the water treatment industry's global demands.

## Pressure Vessel Product Line

ROPV has been engaged in the development and manufacture of FRP pressure vessels and OEM products for over 20 years, and is the largest and the most experienced pressure vessel manufacturer in the Asia/Pacific region. ROPV offers a full-line of 2.5", 4", 8", 16" and 18" pressure vessels, covering all major industry system and application requirements with the maximum operating pressure of 1200 PSI and multiple side port configurations up to 4".







## Pressure Vessel Product Line

### R25E Series



Low Pressure Vessel



High Pressure Vessel

### R40E Series



Low Pressure Vessel



High Pressure Vessel

### R40S Series



Low Pressure Vessel



High Pressure Vessel

### R80E Series



Low Pressure Vessel



High Pressure Vessel

### R80S Series



Low Pressure Vessel



High Pressure Vessel

### R80U Series



### R160E Series



### R160S Series







# R25E Series

## 2.5" Standard Pressure Vessel



### About ROPV

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Today ROPV is the largest pressure vessel manufacturer in China with headquarters in Harbin, Heilongjiang Province, China; manufacturing facility in Dezhou, Shandong Province and global sales office in San Francisco, California, USA.

### OVERVIEW

The ROPV R25E series model accommodates standard make 2.5" membrane filtration elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C), at operating pressures of up to 1,000 PSI / 69 Bar. Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance.



Low Pressure Vessel



High Pressure Vessel

### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available in the following pressure ratings:  
300 Psi, 600 Psi, 1000 Psi

# Product Datasheet

Model R25E 2.5" Standard Pressure Vessel

## R25E Series

Model	Design / Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R2540B300E	300 Psi / 21 Bar	150°F / 66°C	20°F / -7°C	1800 Psi / 126 Bar	40" X 1
R2521B300E	300 Psi / 21 Bar	150°F / 66°C	20°F / -7°C	1800 Psi / 126 Bar	21" X 1
R2514B300E	300 Psi / 21 Bar	150°F / 66°C	20°F / -7°C	1800 Psi / 126 Bar	14" X 1
R2540B600E	600 Psi / 41 Bar	150°F / 66°C	20°F / -7°C	3600 Psi / 246 Bar	40" X 1
R2521B600E	600 Psi / 41 Bar	150°F / 66°C	20°F / -7°C	3600 Psi / 246 Bar	21" X 1
R2514B600E	600 Psi / 41 Bar	150°F / 66°C	20°F / -7°C	3600 Psi / 246 Bar	14" X 1
R2540B1000E	1000 Psi / 69 Bar	150°F / 66°C	20°F / -7°C	6000 Psi / 414 Bar	40" X 1
R2521B1000E	1000 Psi / 69 Bar	150°F / 66°C	20°F / -7°C	6000 Psi / 414 Bar	21" X 1
R2514B1000E	1000 Psi / 69 Bar	150°F / 66°C	20°F / -7°C	6000 Psi / 414 Bar	14" X 1



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# R40E Series

## 4" Standard Pressure Vessel

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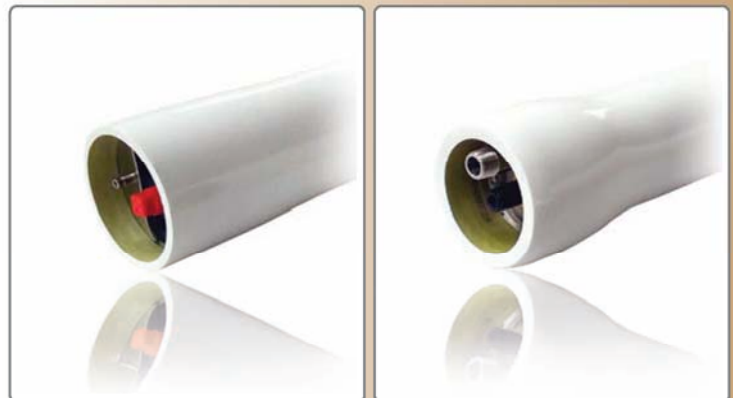
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- Resin System Research
- Fatigue Test of Complex Material Compositions

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### OVERVIEW

The ROPV R40E series model accommodates standard make 4" membrane filtration elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C), at operating pressures of up to 1,200 PSI / 83 Bar. Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance.



Low Pressure Vessel

High Pressure Vessel

### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available in the following pressure ratings:  
300 Psi, 450 Psi, 600 Psi, 1000 Psi, 1200 Psi

## Product Datasheet



# Product Datasheet

Model R40E 4" Standard Pressure Vessel

## R40E Series

Model	Design/ Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R4040B300E	300 Psi / 21 Bar	150° F / 66°C	20°F / -7°C	1800 Psi/126 Bar	40" X (1-6)
R4040B450E	450 Ps / 31 Bar	150° F / 66°C	20°F / -7°C	2700 Psi/186 Bar	40" X (1-6)
R4040B600E	600 Psi / 41 Bar	150° F / 66°C	20°F / -7°C	3600 Psi/246 Bar	40" X (1-6)
R4040B1000E	1000 Psi / 69 Bar	150° F / 66°C	20°F / -7°C	6000 Psi/414 Bar	40" X (1-6)
R4040B1200E	1200 Psi / 83 Bar	150° F / 66°C	20°F / -7°C	7200 Psi/498 Bar	40" X (1-6)



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# R40S Series

## 4" Standard Pressure Vessel

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### OVERVIEW

The ROPV R40S series model accommodates standard make 4" membrane filtration elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C), at operating pressures of up to 1,200 PSI / 83 Bar. Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance.



Low Pressure Vessel

High Pressure Vessel

### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available in the following pressure ratings:  
300 Psi, 450 Psi, 600 Psi, 1000 Psi, 1200 Psi

## Product Datasheet

# Product Datasheet

Model R40S 4" Standard Pressure Vessel

## R40S Series

Model	Design/ Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R4040B300S	300 Psi / 21 Bar	150°F / 66°C	20°F / -7°C	1800 Psi / 126 Bar	40" X (1-6)
R4040B450S	450 Psi / 31 Bar	150°F / 66°C	20°F / -7°C	2700 Psi / 186 Bar	40" X (1-6)
R4040B600S	600 Psi / 41 Bar	150°F / 66°C	20°F / -7°C	3600 Psi / 246 Bar	40" X (1-6)
R4040B1000S	1000 Psi / 69 Bar	150°F / 66°C	20°F / -7°C	6000 Psi / 414 Bar	40" X (1-6)
R4040B1200S	1200 Psi / 83 Bar	150°F / 66°C	20°F / -7°C	7200 Psi / 498 Bar	40" X (1-6)



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# R80E Series

## 8" Standard Pressure Vessel

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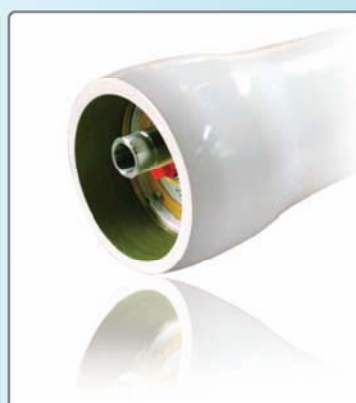
Today ROPV is the largest pressure vessel manufacturer in China with headquarters in Harbin Heilongjiang Province, China; manufacturing facility in Dezhou, Shandong Province and global sales office in San Francisco, California, USA.

### OVERVIEW

The ROPV R80E series model accommodates standard make 8" membrane filtration elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C), at operating pressures of up to 1,200 PSI / 83 Bar. Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance.



Low Pressure Vessel



High Pressure Vessel

### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available Pressure Ratings:  
300 Psi, 450 Psi, 600 Psi, 1000 Psi, 1200 Psi

# Product Datasheet

Model R80E

8" Standard Pressure Vessel

## R80E Series

Model	Design / Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R8040B300E	300 Psi / 21 Bar	150° F / 66°C	20°F / -7°C	1800 Psi / 126 Bar	40' X (1-8)
R8040B450E	450 Psi / 31 Bar	150° F / 66°C	20°F / -7°C	2700 Psi / 186 Bar	40' X (1-8)
R8040B600E	600 Psi / 41 Bar	150° F / 66°C	20°F / -7°C	3600 Psi / 246 Bar	40' X (1-8)
R8040B1000E	1000 Psi / 69 Bar	150° F / 66°C	20°F / -7°C	6000 Psi / 414 Bar	40' X (1-8)
R8040B1200E	1200 Psi / 83 Bar	150° F / 66°C	20°F / -7°C	7200 Psi / 498 Bar	40' X (1-8)



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# R80S Series

## 8" Standard Pressure Vessel

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### OVERVIEW

The ROPV R80S series model accommodates standard make 8" membrane filtration elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C), at operating pressures of up to 1,200 PSI / 83 Bar. Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance. The R80S series model is certified and meets the standards of the ASME [American Society of Mechanical Engineers], Section X, RP.



Low Pressure Vessel



High Pressure Vessel

### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available Pressure Ratings:  
300 Psi, 450 Psi, 600 Psi, 1000 Psi, 1200 Psi

## Product Datasheet



# Product Datasheet

Model R80S

8" Standard Pressure Vessel

## R80S Series

Model	Design/ Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R8040B300S	300 Psi / 21 Bar	150°F / 66°C	20°F / -7°C	1800 Psi / 126 Bar	40" X (1-8)
R8040B450S	450 Psi / 31 Bar	150°F / 66°C	20°F / -7°C	2700 Psi / 186 Bar	40" X (1-8)
R8040B600S	600 Psi / 41 Bar	150°F / 66°C	20°F / -7°C	3600 Psi / 246 Bar	40" X (1-8)
R8040B1000S	1000 Psi / 69 Bar	150°F / 66°C	20°F / -7°C	6000 Psi / 414 Bar	40" X (1-8)
R8040B1200S	1200 Psi / 83 Bar	150°F / 66°C	20°F / -7°C	7200 Psi / 498 Bar	40" X (1-8)



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# R80U Series

## 8" Standard Pressure Vessel



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### OVERVIEW

The ROPV R80U series models accommodates any standard make of 8" UF membrane elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C). Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance.



### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available pressure rating: 150 Psi

# Product Datasheet

Model R80UF

8" Standard Pressure Vessel

## R80U Series

Model	Design/ Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R8060U150S	150 Psi / 10 Bar	150°F / 66°C	20°F / -7°C	900 Psi / 60 Bar	60" X (1-4)

Please refer to the latest ROPV sales drawings for multi-port options.



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# R160E Series

## 16" Standard Pressure Vessel

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### OVERVIEW

The ROPV R160E series models accommodates any standard make of 16" membrane filtration elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C), at operating pressures of up to 1,200 PSI/ 83 Bar. Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance.



### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available Pressure Ratings:  
300 Psi, 450 Psi, 600 Psi, 1000 Psi, 1200 Psi



# Product Datasheet

Model R160E

16" Standard Pressure Vessel

## R160E Series

Model	Design/ Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R16040B300E	300 Psi / 21 Bar	150° F / 66°C	20°F / -7°C	1800 Psi / 126 Bar	40" X (1-8)
R16040B450E	450 Psi / 31 Bar	150° F / 66°C	20°F / -7°C	2700 Psi / 186 Bar	40" X (1-8)
R16040B600E	600 Psi / 41 Bar	150° F / 66°C	20°F / -7°C	3600 Psi / 246 Bar	40" X (1-8)
R16040B1000E	1000 Psi / 69 Bar	150° F / 66°C	20°F / -7°C	6000 Psi / 414 Bar	40" X (1-8)
R16040B1200E	1200 Psi / 83 Bar	150° F / 66°C	20°F / -7°C	7200 Psi / 498 Bar	40" X (1-8)



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# R160S Series

## 16" Standard Pressure Vessel

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- Fatigue Test of Complex Material Compositions

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### OVERVIEW

The ROPV R160S series models accommodates any standard make of 16" membrane filtration elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C), at operating pressures of up to 1,200 PSI / 83 Bar. Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance. The R160S series model is certified and meets the standards of the ASME [American Society of Mechanical Engineers], Section X, RP.



### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available Pressure Ratings:  
300 Psi, 450 Psi, 600 Psi, 1000 Psi, 1200 Psi

## Product Datasheet

# Product Datasheet

Model R160S

16" Standard Pressure Vessel

## R160S Series

Model	Design/ Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R16040B300S	300 Psi/21 Bar	150°F /66°C	20°F/-7°C	1800 Psi/126 Bar	40" X (1-8)
R16040B450S	450 Psi/31 Bar	150°F /66°C	20°F/-7°C	2700 Psi/186 Bar	40" X (1-8)
R16040B600S	600 Psi/41 Bar	150°F /66°C	20°F/-7°C	3600 Psi/246 Bar	40" X (1-8)
R16040B1000S	1000 Psi/69 Bar	150°F /66°C	20°F/-7°C	6000 Psi/414 Bar	40" X (1-8)
R16040B1200S	1200 Psi/83 Bar	150°F /66°C	20°F/-7°C	7200 Psi/498 Bar	40" X (1-8)



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# R180S Series

## 18" Standard Pressure Vessel

### About ROPV

The ROPV technical team is composed of highly knowledgeable and capable team from the FRP Institute specializing in advanced polymer materials, with over 150 combined years of technical and industry experience in composite design and manufacturing.

The ROPV laboratory is an integrated physical and chemical laboratory equipped with advanced equipment to perform testing and analysis in the areas of:

- Finite Element Analysis
- Resin System Research
- Fatigue Test of Complex Material Compositions

Today ROPV is the largest pressure vessel manufacturer in China with headquarters in Harbin Heilongjiang Province, China; manufacturing facility in Dezhou, Shandong Province and global sales office in San Francisco, California, USA.

### OVERVIEW

The ROPV R180S series models accommodates any standard make of 18" membrane filtration elements. Manufactured to very exacting specifications with only the highest quality materials for continuous use. Our pressure vessels operate within a temperature range of 14–150°F (-10–66°C), at operating pressures of up to 1,200 PSI/83 Bar. Individual units are hydro-tested prior to shipment to ensure only the highest quality and stable performance. The R180S series model is certified and meets the standards of the ASME [American Society of Mechanical Engineers], Section X, RP.



### APPLICATION

Our pressure vessels were developed for permeate and feed/concentrate with variable port options, connection types and sizes. They're fully customizable and are offered as OEM equipment for UF, EDI, Large Diameter Membranes and Emerging Water Treatment Technologies.

### FEATURES

- Easy installation and maintenance
- Constructed for best chemical compatibility and corrosion resistance
- Fully customizable and configured based on customer requirements
- Available Pressure Ratings:  
300 Psi, 450 Psi, 600 Psi, 1000 Psi, 1200 Psi

## Product Datasheet



# Product Datasheet

Model R180S

18" Standard Pressure Vessel

## R180S Series

Model	Design/ Operating Pressure	Max. Operating Temperature	Min. Operating Temperature	Qualification Pressure	Element Length
R18060B300S	300 Psi / 21 Bar	150°F / 66°C	20°F/-7°C	1800 Psi / 126 Bar	60" X (1-5)
R18060B450S	450 Psi / 31 Bar	150°F / 66°C	20°F/-7°C	2700 Psi / 186 Bar	60" X (1-5)
R18060B600S	600 Psi / 41 Bar	150°F / 66°C	20°F/-7°C	3600 Psi / 246 Bar	60" X (1-5)
R18060B1000S	1000 Psi / 69 Bar	150°F / 66°C	20°F/-7°C	6000 Psi / 414 Bar	60" X (1-5)
R18060B1200S	1200 Psi / 83 Bar	150°F / 66°C	20°F/-7°C	7200 Psi / 498 Bar	60" X (1-5)



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## Project Snapshot

**BUNDAMBA, AUSTRALIA**

### CAPACITY

50,000 m<sup>3</sup>/day [13.2 mgd]

### INSTALLED UNITS

9 trains of 18" Series

Pressure vessels

13 units per train [total 117]

**START-UP DATE** Jan 2008

## WINNER – Global Water Intelligence Award

The Bundamba Advanced Water Treatment Plant (AWTP) is the winner of the 2008 Global Water Intelligence Award for Global Water Project of the year. AWTP was designed, constructed, commissioned and operating within 39 weeks on budget.

## Bundamba Advanced Water Treatment Project



## BACKGROUND AND CHALLENGES

Due to severe water shortages in Australia water restrictions are fairly common in many regions and cities. The range is from a level 1 to the most extreme level 8, and is also referred to as stages; from 1 to 8, each one more restrictive than the next as you go up. "Water inspectors," are there to implement the rules and issue penalties to people who waste water. South East Queensland's (SQE) normal weather condition is extremely dry, but when the pendulum swings it turns into totally drought conditions. As of this writing the area is at level 6.

In response to these harsh conditions the South East Queensland Water Strategy (The Strategy) has been put in place. It is an adaptive plan whose goal is to meet SEQ's water supply requirements to 2050 and beyond. The Strategy's executive summary states that; *"The Strategy will deliver a Water Supply Guarantee, supplying sufficient water to support a comfortable, sustainable and prosperous lifestyle while meeting the needs of urban, industrial and rural growth and the environment."*

The Bundamba AWTP Located near Ipswich, Queensland, was built to provide an alternative water supply for the region and diminish the pressure on SQE's existing dams and waterways. It is part of a \$2.5bn (AUS) Western Corridor Recycled Water Project. The largest undertaking of its kind in the Southern Hemisphere and is ranked as the world's third-biggest recycled water scheme to date. It will provide 110 MGD (400 MLD) of recycled water to reduce the load on the region's water supply.



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This ambitious project is delivered by an alliance between Black & Veatch/Thiess joint venture in partnership with Western Corridor Recycled Water Pty., Ltd. and the Queensland Government's Department of Planning and Infrastructure and features a network of 200 km of underground pipelines and three new advanced water treatment plants that include: Bundamba, Luggage Island and Gibson Island.

**TECHNOLOGY**

The cutting edge plant provides purified recycled water and is quite unique because it employs combined technologies in micro-filtration membranes, reverse osmosis membranes and advanced oxidation using UV irradiation and peroxide. The Bundamba AWTs employs 18-inch diameter MegaMagnum® reverse osmosis (RO) elements from Koch Membrane Systems (KMS) to reclaim municipal effluent for use as the water supply for cooling towers at the Swanbank and the Torong power stations.

In making the decision to use the world's largest commercially available pressure vessel for their spiral wound RO elements, KMS turned to ROPV of Harbin, China. ROPV was born out of the experts from China's highly reputed and well respected Harbin FRP Design Institute. ROPV developed the R180S pressure vessel to house KMS's 18" x 60" MegaMagnum spiral elements with a surface area of 2,800 ft<sup>2</sup> of membrane surface area versus 400 ft<sup>2</sup> for the commonly used 8" x 40" standard pressure vessels. These pressure vessels were specifically designed to significantly reduce the cost, footprint and installation time of the RO systems.

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## Project Snapshot

### CSDP

TANGSHAN, HEBEI | CHINA

### CAPACITY

50,000 m<sup>3</sup>/day [13 mgd]

### INSTALLED UNITS

5 trains of R80S 8" Series

Pressure vessels

132 units per train [total 660]

START-UP DATE Jan 2012 [Estimated]

*"It seems like an excited dragon awakening from the hundred years silence along with the ever changing situation of a great era and a high rising dream of a great nation. There's a place of legends and dreams attracting the world's attention in the World East, in the forefront of China's contemporary development and in the heartland of the Bohai Sea - She is Caofeidian!"*

On the proposed construction of a huge open harbor with deep water in the Zhili Bay. Based on their ideal they intend to develop this harbor within a limited period and make it as big as New York from the Plans for National Reconstruction by Sun Yat-sen

—Caofeidian Administration Committee

## Caofeidian Seawater Desalination Plant [CSDP]



### Caofeidian: Rising from North China

#### BACKGROUND AND CHALLENGES

As China's industrialization continues to gather steam fueled by rapid economic growth, water consumption grows at an exponential rate. Water supply shortages are acute in urban areas where demand is drastically increasing due to population growth, while other parts of the country are affected by drought. The demand for desalination and reclamation of sewage and wastewater, using water treatment membranes has been steadily growing in China and the RO membrane market continues to expand at a rate exceeding 20% a year.

The Caofeidian Seawater Desalination (CSD) plant is part of the Caofeidian industrial zone (CIZ). It is a 2005-listed pilot area for the development of a Recyclable / Circular Economy. A circular economy refers to an industrial economy that is; by design or intent, restorative and in which materials flows are of two types, biological nutrients, designed to reenter the biosphere safely, and technical nutrients, which are designed to circulate at high quality without entering the biosphere. This site has been designated as a model for the country's environment industrial base and is set to recycle 99.5 percent of its solid waste and 99.7 percent of all wastewater.

The area is 200 km from Beijing, and is located at an important site of Bohai Rim. Caofeidian is strategically located as a passageway form North China to Northeast Asia and the Asia-Europe continental bridge which links inland China and Middle Asia, West Asia and Europe.

Caofeidian, once a small sand spit in the Bohai Bay is a reclaimed land area and has extended into a land of more than 60 square km through sea fillings since 2003. The frame of a modern city is beginning to take shape as crowds of elite technicians and industrial workers swarm to the zone.



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### TECHNOLOGY

One of the basic problems of seawater desalination is the by-product: concentrated seawater. Seawater desalination plants and factories ultimately discharge it back into the ocean because they have no use for it. This causes both favorable and unfavorable consequences. Although the resultant chemicals cause environmental pollution, they also contain NaCl and bromine; important raw materials in the salt chemical industry; and discharging them are considered a waste.

CIZ collaborated with chemical company Tangshan Sanyou Group to construct a combined seawater desalination and chemical plant in the Caofeidian industrial zone, where the by-products of the desalination process will be used for the chemical industry. The combined projects were designed to convert concentrated seawater into raw materials for soda production. Upon the plant's completion, it will process 18 million m<sup>3</sup> of concentrated seawater, extracting over 600,000 tons/year of sodium chloride. The goal of this novel approach is to offer environmental protection while taking advantage of economic advantages it offers.

The CSD plant was nominated for The 2011 Global Water Awards: Desalination Deal of the Year. It is the first 50,000 m<sup>3</sup>/day desalination plant in the most ambitious desalination project in Asia, that will usher in further plans to extend the plant up to a total capacity of 900,000 m<sup>3</sup>/day. Aqualyng and the Development Center of Water Treatment Technology, Hangzhou selected ROPV pressure vessels for the membrane housing. ROPV pressure vessels were born out of the development efforts from the experts of the Harbin FRP Institute. Established in 1984, the institute's designers and researchers worked on advanced polymer materials.

Mr. Li Youqing, ROPV CEO said, "ROPV's total quality management assures the CSD that they are receiving world class performance engineered pressure vessels."

ROPV supplied the Caofeidian Seawater Desalination plant with R80S 8" x 40" high pressure seawater pressure vessels which were developed as part of 5 trains with 132 units each for a total of 660 units that produces a capacity of 50,000 m<sup>3</sup>/day [13 mgd].

The quality of water to be produced at the plant will fully meet the national drinking water standards. The water will be mainly used as industrial water at the Caofeidian industrial development zone and part of the production to be used as drinking water.

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## Project Snapshot

### SCNP, SINGAPORE

#### PHASE I

##### CAPACITY

228,000 m<sup>3</sup>/day [60 mgd]

##### INSTALLED UNITS

10 trains of R80S 8" Series

Pressure vessels

198 units per train [total 1,980]

START-UP DATE May 2009

#### WINNER – Global Water Intelligence Award

The Sembcorp Changi NEWater Plant (SCNP) is the winner of the 2010 Global Water Intelligence Award for Water Reuse Project of the year.

Ropv won the contract for Changi NEWater Plant Phase II

#### PHASE II

##### CAPACITY

228,000 m<sup>3</sup>/day [60 mgd]

##### INSTALLED UNITS

10 trains of R80S 8" Series

Pressure vessels

224 units per train [total 2,240]

START-UP DATE 2016

## Sembcorp Changi NEWater Plant [SCNP]



### BACKGROUND AND CHALLENGES

Singapore is a water stressed country faced with a combination of challenges - possessing a small amount of land and territory, while having a large urban population. And without natural freshwater lakes, the primary domestic source of water is rainfall, collected in reservoirs or storm water collection ponds. In 1965 the PUB was formed to oversee Singapore's water needs, which historically has relied on Malaysia for up to 50% of its daily fresh water consumption. However the water supply provisions from Malaysia has always been regulated by agreements greatly underpinned by uncertainties due to political tensions between the two countries. This long-standing dispute has been ongoing for several decades now, ever since Singapore's independence from Malaysia in 1965. It was only as recent as 2009 that Singapore has managed to reduce its water import reliance from Malaysia down to 40% of total consumption. Due to this continuing tension between the two countries, Singapore is left vulnerable to the risk of cut-off, whether announced or not, of water supply from Malaysia. And with Singapore's water demand increasing at a rate of about 4% over the past decade due to the increase in population and economic development, the Singapore government has proactively engaged in the development of several water related projects to guarantee their self-reliance and sustainability.

### TECHNOLOGY

Singapore's latest water project is a very innovative "*plant-on-plant*" design conceptualized by the PUB that reduces land use and minimizes construction cost. The Sembcorp Changi NEWater Plant (SCNP) is comprised of two sections. The main process facilities of the SCNP were built on the rooftop of the Changi Water Reclamation Plant while the storage tanks were built on land. The PUB





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awarded the contract to Sembcorp, a leading utilities and marine group, based on a Design-Build-Own-Operate agreement to supply NEWater to Singapore over a 25-year period (2010-2035). Black & Veatch a leading global engineering company provided full design engineering services for the plant along with construction support and commissioning services. While the joint venture between Biwater AEWI and Biwater Malaysia was sub-contracted to supply the Reverse Osmosis treatment plant. The plant consists of ten RO trains with three stages at a total of 85% recovery.

Although budgetary costs were an important consideration, quality was never an issue. Every supplier needed to meet the plant's most stringent quality requirements. When Biwater made a decision on the choice of pressure vessel manufacturer, they turned to the largest FRP pressure vessel in the Asia Pacific region – ROPV of Harbin, China. The combination of ROPV's highly competitive operational cost, bulk buying power of raw material resources and unmatched manufacturing experience in the region made the decision easy. Mr. Li Youqing, ROPV CEO said, *"ROPV was born out of the experts from the Chinese government's highly reputed and respected Harbin FRP Design Institute. Established in 1984, the institute's designers and researchers worked on advanced polymer materials. With this knowledge, Biwater is assured that they receive performance engineered pressure vessels from the engineering craftsmen of ROPV."*

ROPV supplied Biwater with close to 2,000 units of R80S 8" x 40" high pressure seawater pressure vessels which were developed as part of 10 trains with 198 units each for a total of 1,980 units that produces a capacity of 228,000 m<sup>3</sup> per day [60 mgd] - this is equivalent to 60 million one-gallon bottles and will supply 15% of Singapore's water needs.

Together, the five NEWater projects meet 30% of Singapore's water needs. And in a further move towards self-reliance the PUB plan to expand the NEWater network of pipelines by up to 87 km (54 miles), a project worth over S\$400 million. When completed, the pipeline will extend from Changi NEWater Plant to Jurong, Tuas, Jurong Island and Sentosa. It will also be linked to existing NEWater pipelines in the Bedok, Seletar, Kranji and Ulu Pandan clusters.

The quality of NEWater consistently exceeds the requirements set by United States EPA and WHO guidelines and is, in fact, cleaner than all current sources of Singapore's water.

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## Project Snapshot

### TSDP, SINGAPORE

#### CAPACITY

318,500 m<sup>3</sup>/day [84 mgd]

#### INSTALLED UNITS

17 trains of R80S 8" Series

SWRO Pressure vessels

216 units per train [total 3,672]

9 trains of R80S 8" Series

LPRO Pressure vessels

132 units per train [total 1,188]

START-UP DATE 2013

*"By 2060, we plan to triple the current NEWater capacity so that NEWater can meet 50% of our future water demand. We also intend to ramp up desalination capacity by almost 10 times so that desalinated water will meet at least 30% of our water demand in the long term."*

↳ PUB

*"This plant marks a significant milestone in Singapore's journey towards water sustainability. Desalinated water is an important pillar of Singapore's Four National Taps and it is set to play an even bigger role. Water demand is expected to double from its current levels by 2060 and we aim to ramp up desalination capacity to meet 30% of the water demand by then."*

↳ PUB Chief Executive Khoo Teng Chye

## Tuaspring Seawater Desalination Plant [TSDP]



Aerial view rendering of the Tuaspring Seawater Desalination Plant courtesy of Hyflux.

### BACKGROUND AND CHALLENGES

Singapore is a water stressed country faced with a combination of challenges - possessing a small amount of land and territory, while having a large urban population. And without natural freshwater lakes, the primary domestic source of water is rainfall, collected in reservoirs or storm water collection ponds. In 1965 the PUB was formed to oversee Singapore's water needs, which historically has relied on Malaysia for up to 50% of its daily fresh water consumption. However the water supply provisions from Malaysia has always been regulated by agreements greatly underpinned by uncertainties due to political tensions between the two countries. This long-standing dispute has been ongoing for several decades now, ever since Singapore's independence from Malaysia in 1965. It was only as recent as 2009 that Singapore has managed to reduce its water import reliance from Malaysia down to 40% of total consumption. Due to this continuing tension between the two countries, Singapore is left vulnerable to the risk of cut-off, whether announced or not, of water supply from Malaysia. And with Singapore's water demand increasing at a rate of about 4% over the past decade due to the increase in population and economic development, the Singapore government has proactively engaged in the development of several water related projects to guarantee their self-reliance and sustainability.

### SINGAPORE'S LARGEST SWRO PLANT

The Tuaspring Seawater Desalination Plant [TSDP] is a 25-year Design-Build-Own-Operate [DBOO] project undertaken by Hyflux. With a capacity of 318,500 m<sup>3</sup>/day [84 mgd], it will be the largest membrane-based seawater desalination facility in Singapore when completed in 2013. This is the



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second and largest municipal desalination plant in Singapore that will be built using reverse-osmosis technology. The proposed plant will be located adjacent to the existing 136,000 m<sup>3</sup>/day (36 mgd) SingSpring plant at Tuas on Singapore's west coast.

The TSDP will produce the world's cheapest desalinated water at S\$0.45/m<sup>3</sup> (\$0.36/m<sup>3</sup>; \$1.36/kgal) once it is completed in 2013. This is made possible because of improvements in membrane technology, the larger scale of the Tuaspring Desalination Plant compared to its predecessor and the integration of an on-site captive 411MW power plant.

New water targets unveiled on 28 June 2010 indicated desalination's bigger role in Singapore's water supply. By 2060, Singapore plans to ramp up desalinated water capacity by almost 10 times, so that the Fourth National Tap can meet at least 30% of the water demand. Water demand is expected to double to 3.45 Million m<sup>3</sup>/day [760 mgd] by 2060.

Mr. Li Youqing, ROPV CEO said, "ROPV's total quality management assures Hyflux and the PUB that they are receiving world class performance engineered pressure vessels. As the PUB continue it's planned goal for long-term sufficiency to meet Singapore's water needs, ROPV will continue to work hand in hand with the EPCs to help achieve this goal."

ROPV supplied the TSDP with:

SWRO 1000 PSI	7 element with 3 inch sideport	17 train x 216 units / train
LPRO 300 PSI	7 element with 3 inch sideport	9 train x 132 units / train

For a total of 4,860 pressure vessels that produces a capacity of 318,500 m<sup>3</sup>/day [84 mgd].

The quality of NEWater consistently exceeds the requirements set by United States EPA and WHO guidelines and is, in fact, cleaner than all current sources of Singapore's water.

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# Certifications

ROPV continues to innovate by developing numerous registered patents related to our manufacturing process and product designs. We've successfully developed a number of OEM products for UF, EDI, large diameter membranes, and emerging water treatment technologies, and is certified by various international-standard-setting bodies.

## CERTIFIED BY

ASME Section X, RP	ACS
CNAS	CE
ISO 9001:2000	WRAS
ISO 14001	NSF 6 1

## PATENTS

FRP Pressure Vessel Patents for Water Treatment

ZL 00 2 12602.8	ZL 2004 3 0015079.2	ZL 2004 2 0018590.2	ZL 2005 3 0020421.2
ZL 00 2 12601.X	ZL 2004 2 0018592.1	ZL 2004 3 0058756.9	ZL 2006 2 0021795.5
ZL 03 3 11187.1	ZL 2004 2 0018591.7	ZL 2005 3 0020422.7	
ZL 03 2 12280.2	ZL 2004 3 0058755.4	ZL 2005 2 0020969.1	

## HONORS

High-Tec Company Certificate

Recommended by the China Membrane Industry Association

National Award for Membrane Science and Technology

Supported by National High Technology Research and Development Program

Supported by China Torch Program

Supported by National 11<sup>th</sup> Term of 5 year research program



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