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AL-INN-0000-ME-DSH-ROR01

Bastidores de Osmose Inversa e ERI

01.0	20/02/2025	Documento inicial	INN	GSI	ACE
Rev.	Dados	Descrição	Criado	Revisto	Aprovado

Editado para:

Informação		Compra	
Aprovação	X	Construção	
Pedido de licitação		Conforme construído	

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1. INTRODUÇÃO

Este documento contém as especificações técnicas dos bastidores de Osmose Inversa e Dispositivos de Recuperação de energia.

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2. FOLHA DE CARACTERÍSTICAS

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REFERÊNCIAS

Número de racks de osmose inversa:	4 Uds.
Serviço/ Local de instalação:	Osmose inversa / Edifício de Osmose Inversa
Fabricante de membranas:	LG Chem ou equivalente
Modelo de membranas:	LG SW 400 R G2
Fabricante de tubos de pressão:	BEL ou equivalente
Modelo de tubos de pressão:	BEL8-S(2x2,5"+2x2")-1200-7M BEL8-S(1x2,5"+1x2")-1200-7M
Fabricante de Dispositivos de Recuperação de energia:	Energy Recovery Inc ou equivalente
Modelo de Dispositivos de Recuperação de energia:	Pressure Exchanger PX-Q400
Catálogo Técnico anexo Nº:	Anexo

CARACTERÍSTICAS BASTIDORES PARA OSMOSE INVERSA

Número de racks de osmose inversa:	4 Uds.
Número de tubos de pressão por rack de osmose inversa:	134 uds
Número de tubos de pressão do tipo 1 (5 portas: 2 entradas 2,5" e 2 saídas 2" + 1 permeado):	400 Uds.
Número de tubos de pressão do tipo 2 (3 portas: 1 entradas 2,5" e 1 saída 2" + 1 permeado):	136 Uds.
Número de bobinas de membrana por tubo de pressão:	7 Uds
Número de bobinas de membrana por rack de osmose inversa:	938 Uds.

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Número total de bobinas de membrana em funcionamento: 3.752 Uds.

Superfície de membrana por bobina de membrana: 37 m²

Superfície de membrana por rack de osmose inversa: 34.706 m²

Peso de um rack vazio: 38.604 Kg approx.

Peso de um rack cheio: 69.960 Kg approx.

MATERIAIS MEMBRANAS

Da membrana Poliamida

Do tubo central de recolha de permeado: ABS

Da película de selagem das bobinas de membrana: Fibra de vidro

MATERIAIS TUBOS DE PRESSAO

Do corte/ tubo de pressão: Vidro/Epoxy acc F.I. 202

Da ligação de entrada de água salgada: Super duplex PREN≥42 (SMO254)

Da ligação de saída de permeado: Engenharia de plástico

Da Ligação de saída de concentrado: Super duplex PREN≥42 (SMO254)

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Dos tampoes/ placas de vedação das extremidades de cada tubo de pressã:

Tampa da extremidade: Engenharia de plástico

Placas de vedação de cada tubo de pressão: StSt16

Da parafusaria: Não são necessários parafusos na montagem da cabeça

Das peças interiores em contacto com a água:

Adaptadores Engenharia de plástico

Selas Termoplástico

Correiras StSt316 coberto com plástico

Selos EPDM

NORMAS TUBOS DE PRESSÃO

De controlo de fabricação: ASME X & European Directive CE

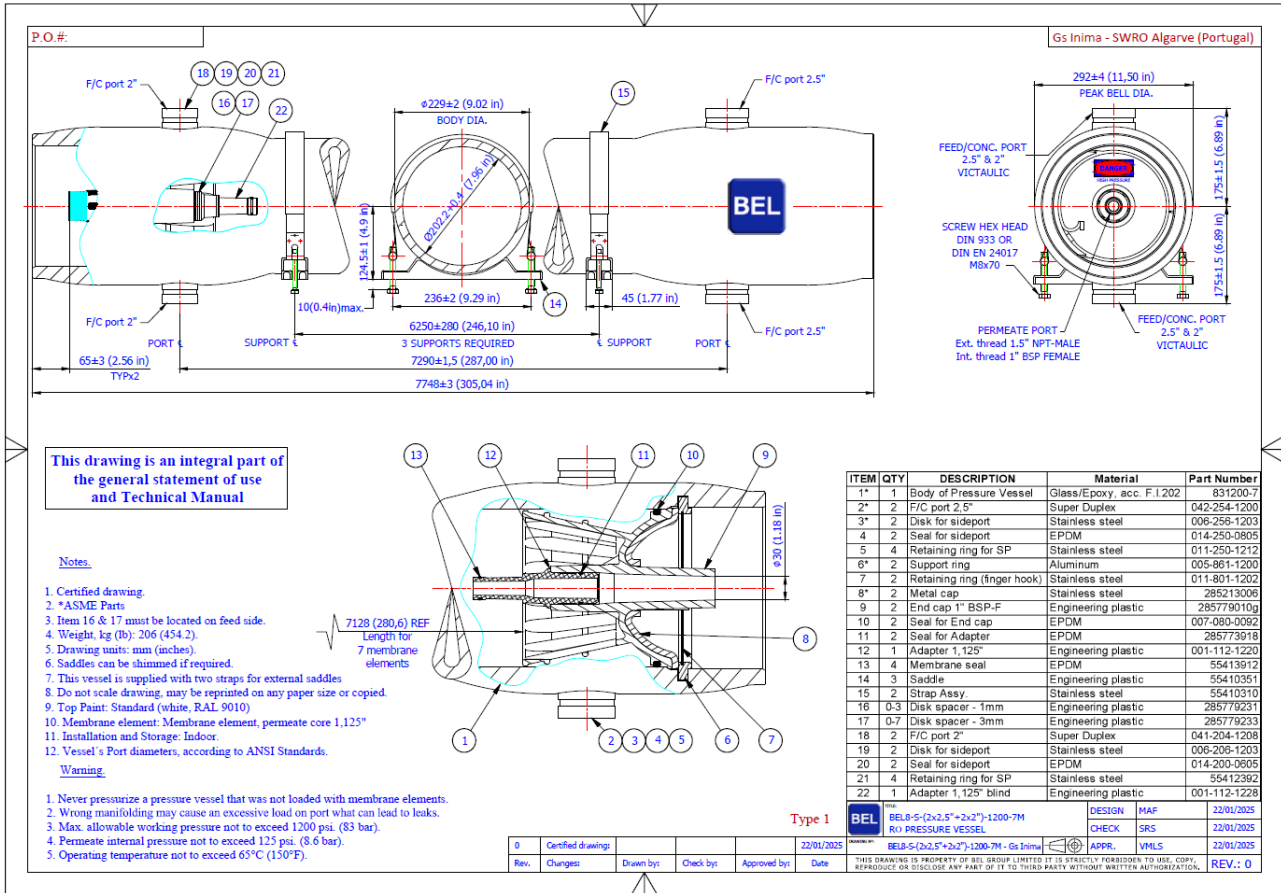
De receção em fábrica: ASME X & European Directive CE

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DESENHO DIMENSIONAL TUBO DE PRESSÃO TIPO 1

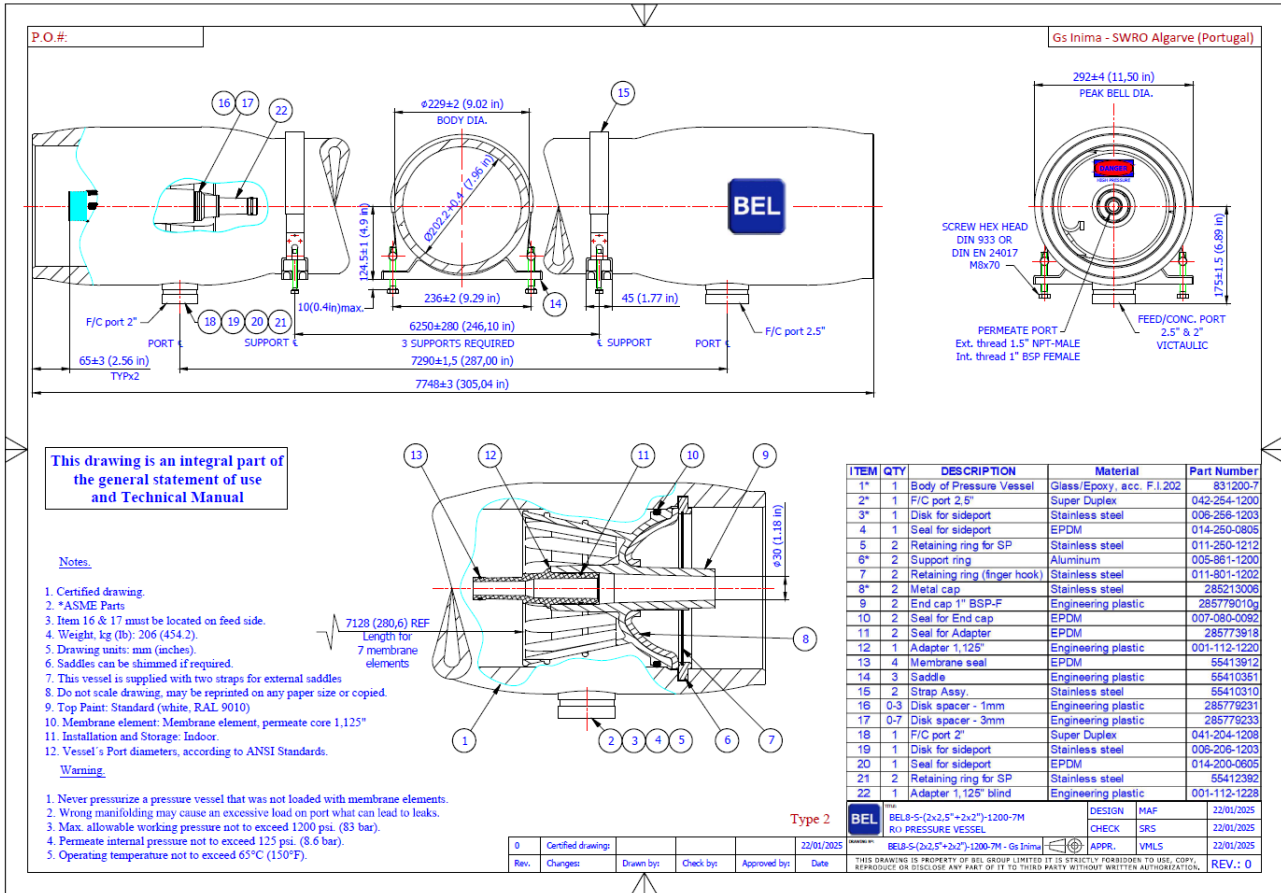


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DESENHO DIMENSIONAL TUBO DE PRESSÃO TIPO 2



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CARACTERÍSTICAS DISPOSITIVO DE RECUPERAÇÃO DE ENERGIA – ERD

Número de unidades:	28 unidades totales (7 unidades / rack)
Gama de caudais de alta pressão:	65,9 – 90,8 m ³ /h
Gama de caudais de baixa pressão	65,9 – 90,8 m ³ /h
Pressão máxima de admissão de salmoura (alta pressão):	82,7 bar
Pressão mínima de saída de água a dessalinizar (baixa pressão):	0,8 bar
Eficiência máxima do EDR:	97,8%
Dimensões gerais:	1.156 x 356 mm (diâmetro máximo)
Tipo de uniões / conexões externas	Grooved-End
Diâmetro da conexão de entrada da baixa pressão:	4"
Diâmetro da conexão de saída da baixa pressão:	4"
Diâmetro da conexão de entrada da alta pressão:	4"
Diâmetro da conexão de saída da alta pressão:	4"
Peso:	164 kg (peso seco), 184,6 kg (peso molhado)

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MATERIAIS

Corpo	PRFV
Rotor	Ceramic-alumina
Veio	Não aplicável
Unhões / conexões externas (entrada e saída da baixa pressão + entrada e saída da alta pressão)	2507 Super Duplex
União / conexão interna da baixa pressão:	Titanium
Parafusos e Porcas	316SS
Vedações	EPDM (gaskets)

NORMAS:

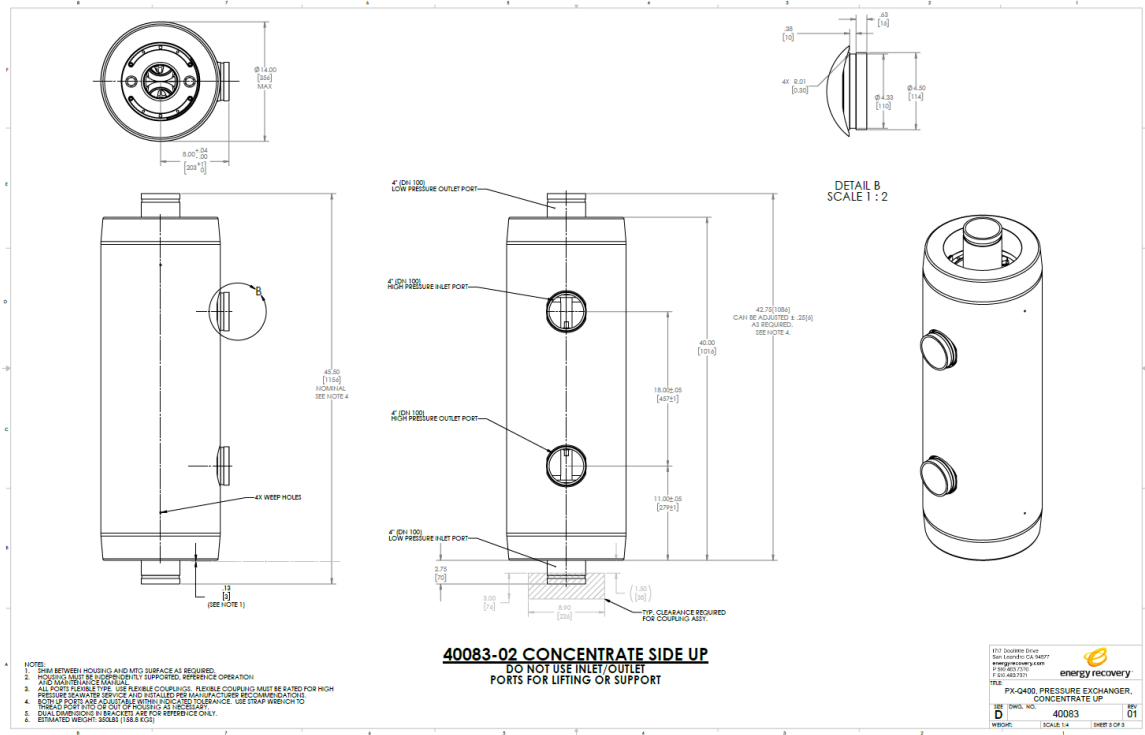
Dimensionais	Manufacturer Standards
Normas de controlo de qualidade:	ISO 9001
Normas de fabrico e ensaio em fábrica:	ASME X (Pressure Vessel) design and test.

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DESENHO DIMENSIONAL



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OUTROS:

Incorporação de materiais reciclados

Incorporação de Resíduos (Sim/Não) Não

Percentagem de incorporação Não aplicável.

Certificado (Sim/Não) Não aplicável.

Compras Ecológicas

Abrangido pela RCM 38/2016, de 29 de julho (Estratégia Nacional para as Compras Ecológicas 2020) (S/N) Não.

Evidências do cumprimento em anexo (Sim/Não) Não aplicável.

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3. CATÁLOGO TECNICO. MEMBRANAS PARA OSMOSE INVERSA



LG Water Solutions

Data Sheet



Seawater
Reverse Osmosis (RO) Membranes
LG SW 400 R G2

Overview

The next generation LG SW G2 membranes have achieved record-breaking salt rejection, improving the product quality up to 45% compared with the conventional technology. With enhanced Thin Film Nanocomposite (TFN) technology, LG SW G2 membranes can significantly reduce the cost of desalination.

LG SW R (High Rejection) membranes offer a combination of high rejection and low energy requirements to reduce the total cost of desalination; suitable for medium to high salinity seawater applications.

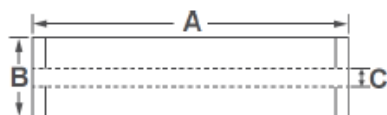
LG SW G2 Benefits

- ▶ Improved permeate quality without increasing operating pressure
- ▶ Reduced energy cost without sacrificing the permeate quality
- ▶ Reduced capital and operation costs for multi-pass SWRO systems

Product Specifications

Active Membrane Area, ft ² (m ²)	Permeate Flow Rate, GPD (m ³ /d)	Stabilized Salt Rejection, %	Minimum Salt Rejection, %	Boron Rejection, %	Feed Spacer, mil
400 (37)	9,000 (34.1)	99.88	99.75	93	34

Test Conditions : 32,000 ppm NaCl, 5 ppm boron at 25°C (77°F), 800 psi (55 bar), pH 8, Recovery 8%.
Permeate flows for individual elements may vary +/-15%.



A, mm (in.)	B, mm (in.)	C, mm (in.)	Weight, kg (lbs.)
1,016 (40)	200 (7.9)	28.6 (1.125)	16 (35)

All dimensional information is indicative and for reference purpose only. Please contact LG Chem for detailed technical specification.

Operating Specifications

For more information and operating guidelines, visit www.lgwatersolutions.com

Max. Applied pressure	1,200 psi (82.7 bar)
Max. Chlorine concentration	< 0.1 ppm
Max. Operating temperature	45°C (113°F)
pH Range, Continuous (Cleaning)	2-11 (2-13)
Max. Feedwater turbidity	1.0 NTU
Max. Feedwater SDI (15 mins)	5.0
Max. Feed flow	75 gpm (17 m ³ /h)
Min. Ratio of concentrate to permeate flow for any element	5 : 1
Max. Pressure drop (ΔP) for each element	15 psi (1.0 bar)

The Membrane Elements performance is expressly conditioned on Buyer's storing, installing, operating, and maintaining Product in accordance with industry-accepted good practices and Seller's written instructions provided in the Seller's Technical Manual, which consists of LG Chem, Ltd [Technical Service Bulletins \("TSB"\)](#) and [Technical Applications Bulletins \("TAB"\)](#) and may be viewed and downloaded at www.lgwatersolutions.com.

The information and data contained herein are deemed to be accurate and reliable and are offered in good faith, but without guarantee of performance. LG Chem assumes no liability for results obtained or damages incurred through the application of the information contained herein. Customer is responsible for determining whether the products and information presented herein are appropriate for the customer's use and for ensuring that customer's workplace and disposal practices are in compliance with applicable laws and other governmental enactments. Specifications subject to change without notice. NanoH₂O is the Trademark of The LG Water Solutions or an affiliated company of LG Chem. All rights reserved. © LG Chem, Ltd.

Contact LG Water Solutions www.lgwatersolutions.com | waterinfo@lgchem.com

(08.21)
NanoH₂O™

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Confidential

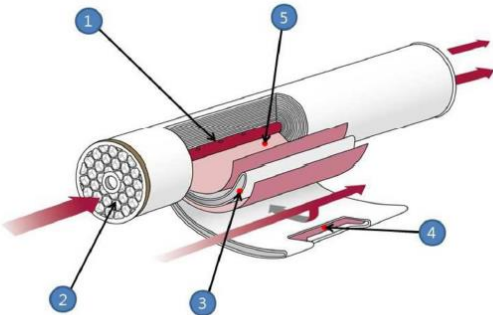
8inch RO Element Drawings (28mil)

Element dimension

: All dimensional information is indicative and for reference purpose only. Please contact LG Chem for detailed technical specification.



Parts schematics



Item No.	DESCRIPTION	QTY
1	CORETUBE	1
2	END CAP (ATD)	2
3	SHEET, MEMBRANE	26
4	PERMEATE SPACER	26
5	FEED SPACER	26

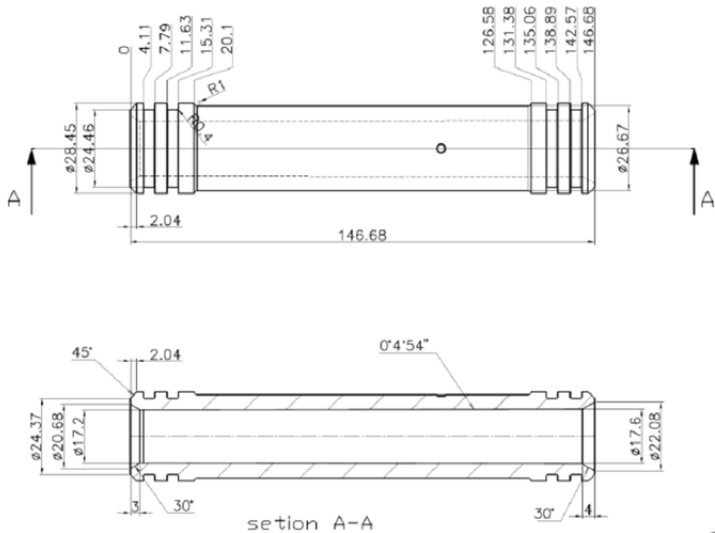
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Cont

Interconnector(SW) Drawings

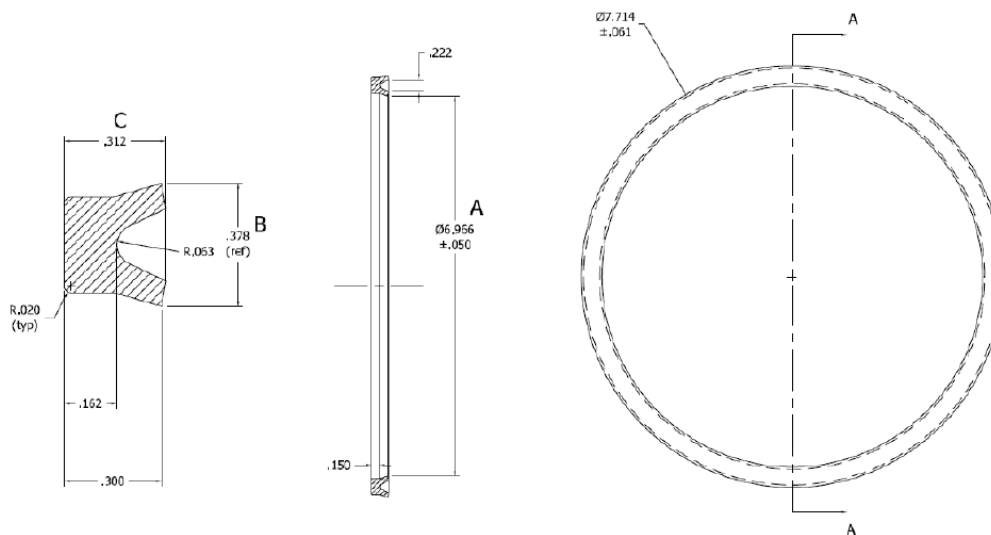


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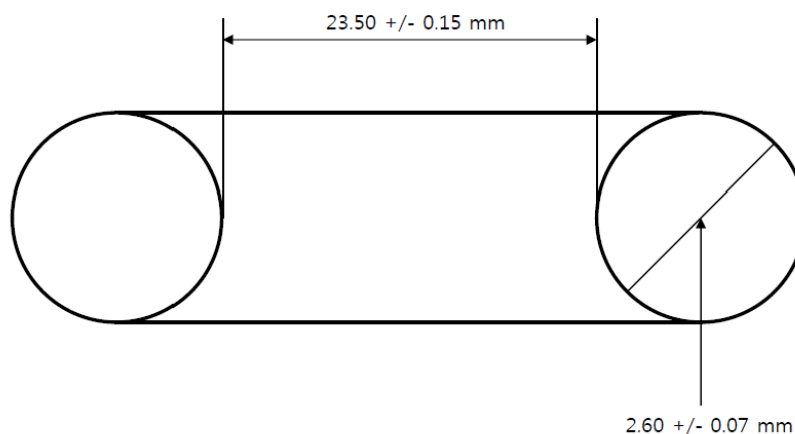
8inch Brine Seal Drawings



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O-ring Drawings

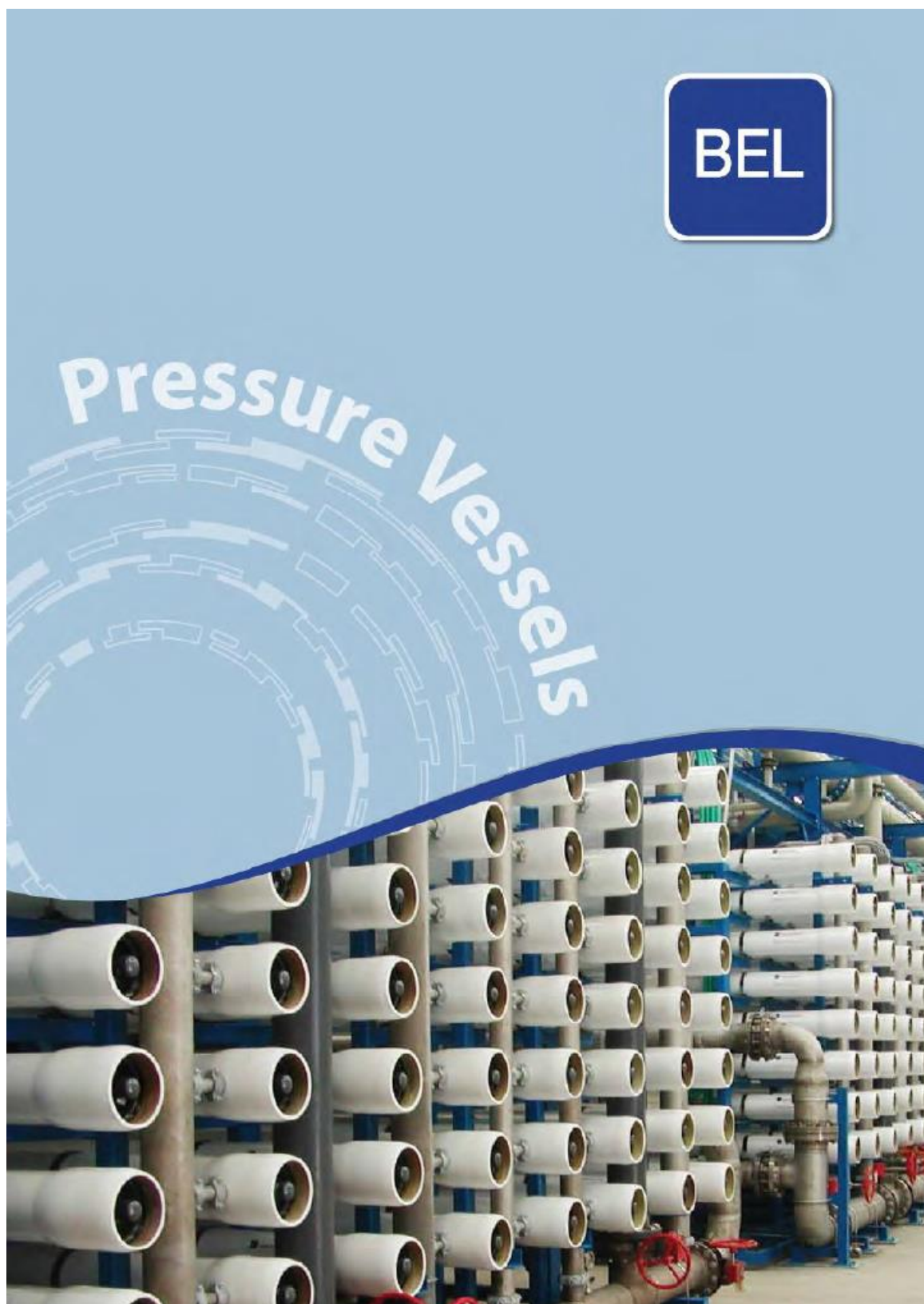


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4. CATÁLOGO TÉCNICO. TUBOS DE PRESSÃO



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PROFILE

BEL is a world specialist manufacturer and vendor of composite made Pressure Vessels (Membrane Housing) and other equipment for the water industry.

Founded in 1966, BEL Group built over the years a strong customers base, first in the process industry and since 1999 in the sea water and brackish water desalination industry with its Composite Material production expertise.

With more than 50 years of experience in the world of composite materials and winding driven products, BEL Group is serving the process and water industries, holding unique wealth of expertise and skilled resources necessary for design, development and manufacturing of advanced composite products from cutting-edge technologies for the chemical and food industries, waste water treatment and water supply.

BEL offers worldwide sales and support services from its state of the art manufacturing plant in Spain and a well-established global chain of logistics and distributors centers.

To date BEL Group supplied more than 100,000 of Pressure Vessels to thousands of projects worldwide from mega-size sea water desalination projects to smaller industrial solutions of different applications, providing a total solution of detailed design, production and installation.



PERFIL

BEL es especialista mundial en fabricación y proveedor de recipientes a presión (tubos de presión para membranas) así como otros equipamientos para la industria del agua.

Fundada en 1966, El Grupo BEL ha desarrollado a lo largo de los años un fuerte vínculo con sus clientes, primeramente en el campo de los procesos industriales y desde 1999 en el campo de la industria de desalación de aguas de mar y salobres, mediante su experta producción de materiales composite. Con una experiencia probada de más de 50 años en el campo de los materiales composite y productos de la tecnología de hilado, el Grupo BEL provee de los expertos y cualificados recursos necesarios para el diseño, desarrollo y fabricación de productos avanzados, mediante tecnologías de vanguardia a las empresas del ramo químico, alimentaria, tratamiento de aguas residuales y suministro de agua.

BEL ofrece servicios de venta y soporte en todo el mundo desde su vanguardista instalación en España y desde su red global de centros de logística y distribuidores.

A día de hoy, BEL ha suministrados más de 100.000 tubos de presión en miles de proyectos a lo largo del planeta, desde mega instalaciones de plantas desaladoras de agua de mar, hasta pequeñas soluciones industriales para diferentes tipos de aplicaciones específicas, proporcionando una solución total de detallados diseños, fabricación e instalación.



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Quality and Reliability

ISO 9001:2000 Certification
 BEL Quality System strictly complies with the ISO 9001: 2000 International Quality standards.

ASME Code Section X Certification
 BEL Pressure Vessels are designed, manufactured and tested according to the strict requirements of the Boiler and Pressure Code of the American Society of Mechanical Engineers (A.S.M.E.) section X, "Fiber Reinforced Plastic Pressure Vessels", the internationally recognized standard for composite Pressure Vessel construction.
 ASME Code Sec. X stamped and NB (National Board) registered Vessels are available upon request.

CE Mark
 BEL's Pressure Vessels are approved to carry the **CE mark** as a proof of the compliance with the **European Pressure Equipment**, Directive 2014/68/EU, replacing Directive P.E.D. 97/23/EC.

Calidad y Fiabilidad

Certificación ISO 9001:2000
 El sistema de calidad del Grupo BEL se ajusta estrictamente a los Estándares Internacionales de Calidad ISO 9001:2000.

Certificación ASME Code Sección X
 Los tubos de presión del Grupo BEL se diseñan, se fabrican y se prueban según los requisitos estrictos de "Boiler and Pressure Code of the American Society of Mechanical Engineers" (ASME), sección X, "Fiber Reinforced Plastic Pressure Vessels", el estándar internacionalmente reconocido para la construcción de recipiente de presión plásticos.
 Estampado ASME Sección X y Registro de tubos de presión en el NB (National Board) disponibles bajo petición.

Marcado CE
 Los tubos de presión de BEL están aprobados para llevar el Marcado CE, como prueba de conformidad con Directiva Europea de Equipos a Presión Directiva 2014/68/EU, que sustituye a la Directiva P.E.D. 97/23/EC.

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Product General Information

- Full range of 16", 8" and 4" Pressure Vessels fits all type membranes that are available in the market.
- Designed for wide range of operation pressure up to 1,500 psi / 102 Bar.
- Available in all configurations, from standard End Port to Side Port and Multiple Port design.
- Multiple Port vessels are available with 1.5", 2", 2.5", 3" & 4" port diameters.
- 9" and 4.6" diameter Pressure Vessel for specific applications.
- 16", 8" & 9" Pressure Vessels, accommodates from 1 to 8 of 40" membranes or 1 to 5 of 60" membranes.
- 4.6" & 4" Pressure Vessels, accommodates from 1 to 6 of 40" membranes or 1 to 4 of 60" membranes.

Información general de productos

- Rango completo de tubos de presión de 16", 8" y 4", para todos los tipos de membranas disponibles actualmente en el mercado.
- Diseñados para el amplio espectro de presiones de operación, hasta 1300 psi / 102 bar.
- Disponibles en todas las posibles configuraciones, desde los estándar Tubos de alimentación/rechazo Frontal (End Port) hasta los de alimentación / rechazo Lateral (Side Port) y las configuraciones alimentación / rechazo Múltiples (Multi Port).
- Tubos de presión Multi Port con puertos disponibles en diámetros de 1.5", 2", 2.5", 3" y 4"
- Tubos de presión de 9" y 4.6" de diámetro para aplicaciones específicas.
- Los tubos de presión de 16", 8" y 9", disponibles para acomodar desde 1 a 8 membranas de 40" o de 1 a 5 membranas de 60" de longitud.
- Los tubos de presión de 4.6" y 4", disponibles para acomodar desde 1 a 6 membranas de 40" o de 1 a 4 membranas de 60" de longitud.

Product Range

GRP 16", 8" and 4" Pressure Vessels (Membrane Housing) for Reverse Osmosis, Nano-Filtration, Ultra-Filtration and general membrane process:

- 16" Side / Multiple Port vessels, 1 to 8 M, from 300 psi to 1,200 psi
- 16" End Port vessels, 1 to 8 M, from 300 psi to 1,200 psi
- 8" Side / Multiple Port / Central Port vessels, 1 to 8 M, from 300 psi to 1,500 psi
- 8" End Port vessels, 1 to 8 M, from 300 psi to 1,500 psi
- 4" Side / Multiple Port vessels, 1 to 6 M, from 300 psi to 1,200 psi
- 4" End Port vessels, 1 to 6 M, from 300 psi to 1,200 psi
- 9" & 4.6" Vessels for Special Applications, ER Devices, U.F. housings, etc., according to specific design.

Rango de productos

Tubos de presión de Poliéster reforzado con fibra de vidrio de 16", 8" y 4", para aplicaciones de Osmosis Inversa, Nano filtración, Ultra filtración y en general para cualquier proceso de membrana:

- Tubos de presión de 16" de diámetro, configuración Side Port o Multi port desde 1 a 8 membranas y presiones desde 300 psi hasta 1,200 psi.
- Tubos de presión de 16" de diámetro, configuración End Port desde 1 a 8 membranas y presiones desde 300 psi hasta 1,200 psi.
- Tubos de presión de 8" de diámetro, configuración Side Port / Multi Port o configuración de puerto central, desde 1 a 8 membranas y presiones desde 300 psi hasta 1,500 psi.
- Tubos de presión de 8" de diámetro, configuración End Port, desde 1 a 8 membranas y presiones desde 300 psi hasta 1,500 psi.
- Tubos de presión de 4" de diámetro, configuración Side Port o Multi Port desde 1 a 6 membranas y presiones desde 300 psi hasta 1,200 psi.
- Tubos de presión de 4" de diámetro, configuración End Port desde 1 a 6 membranas y presiones desde 300 psi hasta 1,200 psi.
- Tubos de presión de 9" y 4.6", para aplicaciones especiales, equipos ER, UF, etc., conforme a diseños específicos.



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Efficient Pressure Vessel Design

- **Unique and simple End Cap design:**
 - Easy locking system with no contact of metal with salted water.
 - Fewer parts in the head assembly, therefore less spare parts are required.
 - Less sealing points, therefore less maintenance is required.
 - 30 mm ID free flow permeate ports on both sides with 3 connections options: 1.5" NPT (M) / 1.5" Victaulic grooved connection / 1" BSP (F) / Any other (by request)
- **No metal inserts embedded inside the F.R.P. laminate:**
 - Corrosion Free.
 - Secured structural Strength.
- **Mechanical connection of the Side Ports to the vessel body:**
 - Not glued and not threaded ports connection.
 - Flexible and without dead zone.
 - Replaceable and easy to handle.
- **Multiple Ports connection:**
 - Efficient, flexible and cost effective design.
 - Cost reduction on plant construction material such as steel frame, pipes, fittings, labor and accessories.
 - Smaller foot-print.
 - Lower Long-Term maintenance expenses.



Tubos de presión con diseño Eficiente

- **Sencillo y Exclusivo Diseño de tapa**
 - Sencillo Sistema de cierre sin contacto alguno de partes metálicas con agua salina.
 - Mínimas partes en conjunto de cierre del tubo de presión, lo cual implica menores requerimientos de piezas de repuesto.
 - Menores puntos de sellado, lo cual reduce los requerimientos de mantenimiento.
 - Puertos de permeado con 30 mm de diámetro interior libre en ambos lados del tubo de presión, con 3 opciones de conexión: 1.5" NPT Macho / 1.5" ranurado victaulic / 1" BSP Hembra. Otras posibilidades, bajo petición expresa.
- **Inexistencia de insertos metálicos en la fibra**
 - Libre de corrosión.
 - Refuerzo estructural asegurado.
- **Conexión totalmente mecánica entre los puertos y el cuerpo del tubo de presión**
 - Conexión de los puertos no pegados o roscados en la fibra.
 - Flexible y sin zonas muertas.
 - Remplazable y de fácil manejo.
- **Conexiones multipuerto:**
 - Diseño eficiente, flexible y rentable en el cómputo general del diseño de la instalación.
 - Reducción de costes en fabricación de la planta en materiales tales como bastidores metálicos, tuberías, conexiones, accesorios y mano de obra asociada.
 - Reducción de espacio necesario para la instalación.
 - Menores costes de mantenimiento a largo plazo.



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BEL

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Cliente 		Empreiteiro EPC   		
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FICHA TÉCNICA



TECHNICAL DATA SHEET

Pressure Vessel
SWRO Plant – Algarve - Portugal



GS Inima
LUSÁGUA

TECHNICAL DATASHEET		
CUSTOMER:		GS INIMA - LUSAGUA
Customer PO:		SWRO Plant – Algrave - Portugal
GENERAL		
Number of Units		400
Manufacturer		BEL COMPOSITE IBERICA S.L. – SPAIN - EU
Model/Type		BEL8-S(2x2,5"+2x2")-1200-7M
Service		Membrane housings
Membrane		TBD (To be defined)
Settlement in plant		Reverse Osmosis
TECHNICAL SPECIFICATIONS		
Capacity		7 membranes per vessel
Head Diameter	mm	292 ± 4
Body Diameter	mm	229 ± 2
Internal Diameter	mm	202,2 ± 0,4
Design Pressure	psi/bar	1.200 psi / 82,74 bar
Maximum Operating Pressure	psi/bar	1.200 psi / 82,74 bar
Minimum Operating Pressure	psi/bar	14,5 psi / 1,00 bar
Nominal Pressure	psi/bar	1.200 psi / 82,74 bar
Test Pressure		1.320 psi / 91,01 bar
Burst Pressure	psi/bar	7.200 psi / 496,42 bar
Maximum & Minimum Operating Temperature	°F/°C	Max. 150 °F / 65 °C — Min. 41 °F / 5 °C
Internal Volume	Liters	236,90
Total Length	mm	7.748 ± 3
Distance between ports	mm	7.290 ± 1,5
Height of ports	mm	175 ± 1,5
Support Spam	mm	6.250 ± 280
Approx. empty weight:	kg	206,0
Connection type		
Feed - Inlet		2 Units Lateral for victaulic connection 2,5"
Brine - Exit		2 Units Lateral for victaulic connection 2"
Permeate Exit		2 Units Frontal Central - Ext. thread 1,5" NPT male - Int. thread 1" BSP female
MATERIALS		
Body		Glass/Epoxy acc F.I. 202
Feed / Reject ports		Super duplex PREN ₂ 42 (SMO254)
Permeate Exit		Plastic Engineering (Embedded in End Cap)
End Caps		Plastic Engineering
Metal Caps		StSt316
Support Rings		Hard Anodized Aluminum.
Retaining Rings		StSt316
Adapters		Plastic Engineering
Saddles		Thermoplastic
Straps		StSt316 covered with plastic
Seals		EPDM
DESIGN CODE		
Standard for Manufacture		ASME Section X – Class I
Pressure Test	psi/bar	ASME Section X (1,1 the design pressure, for >1 min)
Certificate of Conformity CE	yes	Included
CE Mark		Applicable
ACCESSORIES		
Vessel's support / saddles		Yes
End caps		Yes
Adapters		Yes – Standard & blind
Disc Spacers		Yes / 3 Units of 1 mm & 7 Units of 3 mm thickness, per vessel.
Retaining ring & support rings		Yes
Number of saddles	Units	3
Number of Straps	Units	2
Pressure vessel manufactured according to ASME Section X requirements, for pressure vessels manufactured by Filament-winding process, Class I.		

Cliente 		Empreiteiro EPC   		
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TECHNICAL DATA SHEET

Pressure Vessel
SWRO Plant – Algarve - Portugal



TECHNICAL DATASHEET		
CUSTOMER:		INNICE – GS INIMA - LUSAGUA
Project:		SWRO Plant Algarve - Portugal
GENERAL		
Number of Units		136
Manufacturer		BEL COMPOSITE IBERICA S.L. – SPAIN - EU
Model/Type		BEL8-S(1x2,5"+1x2")-1200-7M
Service		Membrane housings
Membrane		TBD (To be defined)
Settlement in plant		Reverse Osmosis
TECHNICAL SPECIFICATIONS		
Capacity		7 membranes per vessel
Head Diameter	mm	292 ± 4
Body Diameter	mm	229 ± 2
Internal Diameter	mm	202,2 ± 0,4
Design Pressure	psi/bar	1.200 psi / 82,74 bar
Maximum Operating Pressure	psi/bar	1.200 psi / 82,74 bar
Minimum Operating Pressure	psi/bar	14,5 psi / 1,00 bar
Nominal Pressure	psi/bar	1.200 psi / 82,74 bar
Test Pressure		1.320 psi / 91,01 bar
Burst Pressure	psi/bar	7.200 psi / 496,42 bar
Maximum & Minimum Operating Temperature	°F/°C	Max. 150 °F / 65 °C — Min. 41 °F / 5 °C
Internal Volume	Liters	236,90
Total Length	mm	7.748 ± 3
Distance between ports	mm	7.290 ± 1,5
Height of ports	mm	175 ± 1,5
Support Spam	mm	6.250 ± 280
Approx. empty weight:	kg	206,0
Connection type		
Feed - Inlet		1 Units Lateral for victaulic connection 2,5"
Brine - Exit		1 Units Lateral for victaulic connection 2,5"
Permeate Exit		2 Units Frontal Central - Ext. thread 1,5" NPT male - Int. thread 1" BSP female
MATERIALS		
Body		Glass/Epoxy acc F.I. 202
Feed / Reject ports		Super duplex PREN-42 (SMO254)
Permeate Exit		Plastic Engineering (Embedded in End Cap)
End Caps		Plastic Engineering
Metal Caps		StSt316
Support Rings		Hard Anodized Aluminum.
Retaining Rings		StSt316
Adapters		Plastic Engineering
Saddles		Thermoplastic
Straps		StSt316 covered with plastic
Seals		EPDM
DESIGN CODE		
Standard for Manufacture		ASME Section X – Class I
Pressure Test	psi/bar	ASME Section X (1,1 the design pressure, for >1 min)
Certificate of Conformity CE	yes	Included
CE Mark		Applicable
ACCESSORIES		
Vessel's support / saddles		Yes
End caps		Yes
Adapters		Yes – Standard & blind
Disc Spacers		Yes / 3 Units of 1 mm & 7 Units of 3 mm thickness, per vessel.
Retaining ring & support rings		Yes
Number of saddles	Units	3
Number of Straps	Units	2
Pressure vessel manufactured according to ASME Section X requirements, for pressure vessels manufactured by Filament-winding process, Class I.		

Cliente 		Empreiteiro EPC   		
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PROGRAMA DE PONTOS DE INSPECÇÃO

Client			EPC Contractor					
Project No,	Project ALGARVE – RO Desalination Plant				Date	Rev,		
Document n°/Title AL-GSI-IT-QC-0000-PLV01_IPP for Pressure Vessel					02/01/2025	00A		

ITEM Nº	ITEM DESCRIPTION	TEST	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	QUALITY RECORDS	INSPECTION RESPONSIBILITY (HOLD/WITNESS/REVIEW)				
						Supplier	EPC	Owner	Others	Remarks
1 DOCUMENTS										
1.1	Test procedure: Hydrostatic test, Barcol test, Visual & dimensional test, volumetric expansion	Check of documents	Manufacturer procedure	Technical Specification - Data sheet	Documents	T1	AR	R		
1.2	Painting Procedure	Check of documents	Manufacturer procedure and instruction	Technical Specification	Documents	T1	AR	R		
2 MATERIAL										
2.1	epoxy resin, fiber glass, plastic, elements	Chemical analysis	Reference standard for material	Reference standard for material ASTM codes / ASME X	Certificate EN 10204:2004, Type 2.1/2.2 for NON- metallic parts	R	R	R		Hardener: ANALYSIS CERTIFICATE Resin and Reinforcing fiber: CERTIFICATE OF ANALYSIS Seals, end caps etc: TECHNICAL DATASHEET or CERTIFICATE OF ANALYSIS
2.2	Quality certificates of ports, spiral rings and caps/ plates	Chemical analysis	Reference standard for material	Reference standard for material	Material certificate	R	R	R		Retaining rings: CERTIFICATE OF CONFORMANCE Support, side port, disk for side port, metal cap: 3.1 CERTIFICATE
3 MANUFACTURING										
3.1	Manufacturing process of housing	Visual Inspection	ASME X	ASME X (6-100-1)	Manufacturing report	T1	R	R		
4 TEST										
4.1	Volume expansion test	Volumetric expansion, Min 10% of bodies	ASME X article RQ	ASME Sec X/2023 Article RQ and supplier procedure	Test report	T2	RQ	RQ		Information included in the attached inspection certificate Acc. EN 10204/A.1. Only One document for all information and per pressure vessels model and its serial number
4.2	Visual examination. Assembly of housing, caps and seals	Visual Inspection	Test procedure (ASME Sec. X 2023)	ASME Sec X/2023 (Part RT Article RT-410)	Test report	T2	W2	R		Information included in the attached inspection certificate Acc. EN 10204/A.1. Only One document for all information and per pressure vessels model and its serial number
4.3	Barcol Hardness Control	Barcol Hardness	Test procedure (ASME Sec. X 2023)	ASME Sec X/2023 (Part RT Article RT-440)	Test report	T2	R	R		

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Cliente 		Empreiteiro EPC   		
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Client		EPC Contractor	
Project No.	Project ALGARVE – RO Desalination Plant	Date	Rev.
Document n°/Title AL-GSI-IT-QC-0000-PLV01_IPP for Pressure Vessel		02/01/2025	00A

ITEM Nº	ITEM DESCRIPTION	TEST	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	QUALITY RECORDS	INSPECTION RESPONSIBILITY (HOLD/WITNESS/REVIEW)				
						Supplier	EPC	Owner	Others	Remarks
1	DOCUMENTS									
4.4	Dimensional control after machining of housing and caps. Verification of thickness and linearity of tubes	Body Dimension (Thickness, partial and total dimension)	Test procedure (ASME Sec. X 2023)	ASME Sec.X/2023 (Part RT Article RT-420)	Test report	T2	R	R		Information included in the attached inspection certificate Acc. EN 10204/3.1. Only One document for all information and per pressure vessels model and its serial number
4.5	Weight of the housing	Weight	Test procedure (ASME Sec. X 2023)	ASME Sec.X/2023 (Part RT Article RT-430)	Test report	T2	R	R		Information included in the attached inspection certificate Acc. EN 10204/3.1. Only One document for all information and per pressure vessels model and its serial number
4.6	Hydrostatic pressure test	Hydrostatic test	Test procedure (ASME Sec. X 2023)	ASME Sec.X/2023 (Part RT Article RT-450.1)	Test report	T2	R	R		Information included in the attached inspection certificate Acc. EN 10204/3.1. Only One document for all information and per pressure vessels model and its serial number
4.7	Painting quality, cleanliness, thickness, finishing and adhesives	Painting control	Manufacturer procedure	Manufacturer procedure	Test report	One for batch	One for batch	R		
5	FINAL CHECK									
5.1	Final and visual inspection	Visual and Dimensional examination	Technical specification – drawings	Technical specification – drawings	Inspection report	W1	W2	R		
5.2	Marking and labelling	Labelling check	Technical specification – drawings ASME X	Technical specification – drawings ASME X	Inspection report	W1	W2	R		
5.3	Completeness supply check according to the purchase order	Check of material	Technical specification Purchase Order	Technical specification Purchase Order	Inspection report	W1	W2	R		
5.4	Packed material	Preservation and packing inspection	Packing procedure	Packing procedure	Inspection report	W1	W2	R		
5.5	Guarantee certificate	Guarantee	Technical specification	Technical specification	Guarantee certificate	R	R	R		
5.6	Compliance certificate (Agreement to Contract or PO)	Compliance	Technical specification	Technical specification	Compliance Certificate	R	R	R		
5.7	Manufacturing Data record	Check of document	Quality documents	Quality documents	MOR	R	AR	R		
5.8	Acceptation Note	Check of document	Quality documents	Quality documents	Acceptance Note		R			
5.9	Logistics Dossier	Check of document	Logistics documents	Logistics documents	Logistic Dossier	R	AR			
5.10	Delivery Authorisation		Documents	Documents		H				

Legend:

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ITEM Nº	ITEM DESCRIPTION	TEST	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	QUALITY RECORDS	INSPECTION RESPONSIBILITY (HOLD/WITNESS/REVIEW)				
						Supplier	EPC	Owner	Others	Remarks
1	DOCUMENTS									

T: Test – R: Review of doc.(Doc. to send) – AR: Approval required – W: witness – H: hold – S: surveillance
 1 = 100% • 2 = min, 1%

Notes

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REFERÊNCIAS



MANUFACTURER REFERENCES Pressure Vessels

BEL Composite Ibérica REFERENCES & CASE STUDY.

<i>BEL VESSELS GENERAL REFERENCES.</i>				
<i>PLANT NAME</i>	<i>COUNTRY</i>	<i>CONTRACTOR</i>	<i>CAPACITY</i>	
Perth II	Australia	TRSA / Valoriza Agua	250.000	m³/d
Az-Zour South SWRO	Kuwait	Veolia	136.000	m³/d
Gold Coast	Australia	Veolia / J. Holland	125.000	m³/d
Al Jubail phase 4	Saudi Arabia	PCMC / Acciona	103.500	m³/d
Al Jubail phase 2	Saudi Arabia	Al Fatah Water & Power	100.000	m³/d
Pacific Rubiales	Colombia	Nirosoft	79.500	m³/d
Larnaca	Cyprus	LWP / IDE	64.000	m³/d
Escombreras	Spain	Cobra / Tedagua	60.000	m³/d
Valisikos	Cyprus	I. D. E.	60.000	m³/d
El Agodor	Spain	Aqualia	58.400	m³/d
Trekkojje Mine	Namibia	Keyplan	55.000	m³/d
Bajo de Almanzora	Spain	Aqualia/Befesa/FCC	50.000	m³/d
Paphos	Cyprus	Protecno	45.000	m³/d
Limassol	Cyprus	Mekorot / Netcom Group	40.000	m³/d
Mossel Bay skids	South Africa	Veolia Ibérica	37.500	m³/d
YuHuan	China	Siemens	36.000	m³/d
MODEC Offshore	Angola	VWS Westgarth	31.800	m³/d
Eemshaven RWE	Netherlands	Veolia Deutschland	30.000	m³/d
Medupi Power Station	South Africa	Ovivo (Aqua Eng.)	30.000	m³/d
Blue Hills	Bahamas	Consolidated Water	26.500	m³/d
Emirates Steel	UAE	Danieli	28.800	m³/d
Suministros	Algeria	M. S. D.	25.500	m³/d
Rincón de León	Spain	Cadaqua	25.000	m³/d
W.E.B. Aruba	Aruba	VWS / OTV	24.000	m³/d
Sagunto	Spain	Grupo Seta	23.000	m³/d
Moncofa	Spain	Inima	23.000	m³/d
Moni	Cyprus	Nirosoft /Subsea Infraest.	22.000	m³/d
Pal Technology Services	UAE	Fluid Technology Int'l Pvt Ltd	20.900	m³/d
La Caleta	Spain	Aqualia	20.000	m³/d
Consol Energy	USA	H2O Innovation	18.900	m³/d
Point Fortin	Trinidad	Seven Seas. Inc.	17.400	m³/d
Costa del Sol	Spain	Endesa	16.000	m³/d
Agua's Ponta Preta	Cape Verde	TCA	15.000	m³/d
Petrobras Offshore	Brazil	VWS Westgarth	15.000	m³/d
Puerto del Rosario	Spain	Degremont	14.000	m³/d
PTOI Placilla	Chile	Hidrosan	14.000	m³/d
NieuWater Emmen	Netherlands	Logisticon	13.200	m³/d
Komati	South Africa	Ovivo (Aqua Eng.)	12.000	m³/d
Owassa	USA	Befesa	11.000	m³/d
Doolittle	USA	Befesa	11.000	m³/d
Hilton Head	USA	Water & Power Technologies	11.000	m³/d

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MANUFACTURER REFERENCES
Pressure Vessels

<i>BEL VESSELS GENERAL REFERENCES.</i>				
<i>PLANT NAME</i>	<i>COUNTRY</i>	<i>CONTRACTOR</i>	<i>CAPACITY</i>	
Mantoverde	Chile	Sadyt	10.400	m³/d
Adeje Arona	Spain	GE Ionics	10.000	m³/d
Enlarg Ceuta	Spain	Cadaqua	10.000	m³/d
Aguas Porto Novo	Cape Verde	TCA	10.000	m³/d
Marsa Alam	Egypt	Metito Overseas	10.000	m³/d
Curaçao Water Plant	Curaçao	Seven Seas Water	9.400	m³/d
St. Croix Water	US Virgin Is.	Seven Seas Water	9.400	m³/d
Altona, Melbourne	Australia	Tedagua / Drace	9.000	m³/d
Power Station La Spezia	Italy	T.M.E.	9.000	m³/d
Shat Al Basra	Iraq	VWS Gulf	9.000	m³/d
Saint John's	Antigua	Enerserve / Veolia	8.500	m³/d
Estate Richmond Power Plant	St. Croix	Seven Seas Inc.	8.325	m³/d
Randolph E Harley Power Plant	St. Thomas	Seven Seas Inc.	8.300	m³/d
Engelse Werk	Netherlands	Vitens / VWS Rossmark	8.250	m³/d
C.C.C. Campo de Gibraltar	Gibraltar	Onde Degremont	8.000	m³/d
Donna	USA	Befesa	7.500	m³/d
Paguera, Malaga	Spain	Cadagua	7.500	m³/d
South Coast Steam	USA	Aquatech International	7.500	m³/d
Baiji Power Plant	Iraq	VWS Gulf	7.100	m³/d
Tortola, BVI Plant	Virgin Is.	DesalCo	5.440	m³/d
C.T.C.C. Tarragona	Spain	Endesa	5.400	m³/d
Lei Ji Power Plant	China	GZ AsianTec	5.000	m³/d
Reliance	Algeria	Veolia	4.600	m³/d
Las Galletas	Spain	GE Ionics	4.000	m³/d
Pepsico Baghdag	Iraq	Bekerfeld	3.900	m³/d
Boleo	Mexico	Aquatech International	3.750	m³/d
New York Power	USA	Veolia Water	3.750	m³/d
SWRO	Libya	Metito Overseas	2.750	m³/d
North Sound. Cayman	Cayman Is.	DesalCo	2.640	m³/d
Sharm el-Sheikh	Egypt	WWWS	2.600	m³/d
Masar Alam	Egypt	Metito Overseas	2.500	m³/d
SWRO	Libya	Metito Overseas	2.500	m³/d
Syros Island	Greece	TEMAK	2.500	m³/d
CTCC Sagunto	Spain	Sadyt	2.500	m³/d
La Ranilla	Spain	Aqualia	2.000	m³/d
Isla San Andrés	Colombia	Crupo CORSA	2.160	m³/d
Bir Shalateyn	Egypt	ISO	2.000	m³/d
Sohar	Oman	Berkefeld	1.730	m³/d
Al Dibba bottling plant	UAE	Berkefeld	1.500	m³/d
Pepsico Arabia bottling plant	Saudi Arabia	Veolia	1.500	m³/d
Brabant Water	Netherlands	Logisticon	1.200	m³/d
Sohar	Oman	Berkefeld	1.000	m³/d
EMPOWER Dubai Health Care City	UAE	VWS Gulf	1.000	m³/d

Cliente 		Empreiteiro EPC   		
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MANUFACTURER REFERENCES
Pressure Vessels

<i>BEL VESSELS GENERAL REFERENCES.</i>				
<i>PLANT NAME</i>	<i>COUNTRY</i>	<i>CONTRACTOR</i>	<i>CAPACITY</i>	
Al Yassat Island	UAE	Waterworks	750	m³/d
Al Yassat Island	UAE	Waterworks	750	m³/d
Containerised SWRO	Oman	Veolia	500	m³/d
Mobile water treatment	Iraq	Waterworks	500	m³/d
Containerised SWRO	Tunisia	Lenntech	500	m³/d
Containerised SWRO	Oman	Veolia	500	m³/d
Containerised SWRO	Tunisia	Lenntech	500	m³/d
Ajman Labour Camp	UAE	Aquastar	400	m³/d
Karachi Industrial	Pakistan	Fluid International	400	m³/d
Karachi Industrial	Pakistan	Aquastar	400	m³/d
Sharjah Labour Camp	UAE	Extraco	400	m³/d
Ajman Labour Camp	UAE	Aquastar	400	m³/d
Um al Quwain labour camp	UAE	Seven Seas	400	m³/d
Al Ain Irrigation	UAE	Al Shottan	300	m³/d
Al-Saad Irrigation	UAE	Haader Agricultural	325	m³/d
Al Ain Irrigation	UAE	Al Shottan	300	m³/d
Ras al Khaimah irrigation	UAE	Al Mawrid	300	m³/d
Ras al Khaimah irrigation	UAE	Al Mawrid	300	m³/d
Containerised SWRO	Kenya	Gulf Water Treatment	300	m³/d
Abu Samra Irrigation	UAE	Haader Agricultural	170	m³/d
Containerised SWRO	Kenya	Gulf Water Treatment	60	m³/d

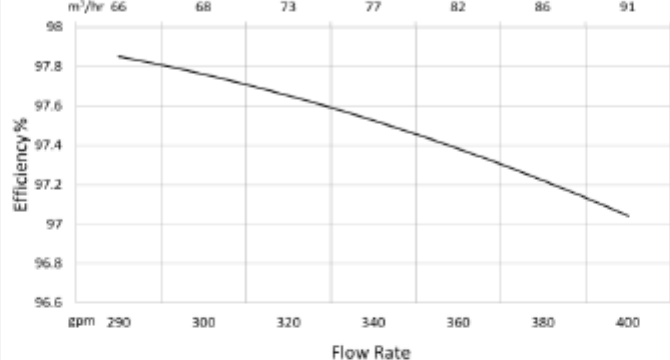
Cliente 		Empreiteiro EPC   			
Projeto nº.	Projeto	Data	Rev.	Pág.	
	Sistema de dessalinização na região do Algarve	20/02/2025	01.0	30 de 50	
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		1717 Doolittle Dr. San Leandro, CA 94577, USA Phone: 1-510-483-7370	Energy Recovery, Inc. Specifications Sheet PX-Q400	REV	BY	CKD	REVISION	DATE
DESCRIPTION: TECHNICAL DATA SHEET, POSITIVE DISPLACEMENT ENERGY RECOVERY DEVICE		Sheet Page 1 of 1	Document number: 80872-01	00	AKP	CD	Initial Release	12-Dec-22
				01	AKP	KYK	Updated Shipping Weights and dim. Added Interconnect Spacer Material	8-May-23
1. Part number 40083 & 40085			2. Service SWRO		3. Reference			
OPERATING CONDITIONS	4	Liquid	Seawater	45	TESTS	Performance		Standard
	5	Operating Temperature	33°F-120°F (0.6-49°C)	46		Case Hydrotest		Standard
	6	Max. Temperature	120°F (49°C)	47		Rotation Speed Test		Standard
	7	Specific Gravity	1.03	48		Die Penetrant Test (ceramics)		Standard
	8	Viscosity	1.060 cP @ 70°F (21.1°C)	49		Witnessed Test		Optional
	9	Flow range	290 - 400 gpm (65.9-90.8 m3/h)	50				
	10	Maximum High-Pressure Inlet Flow	400 gpm (90.8 m3/h)	51				
	11	Maximum Low-Pressure Outlet Flow	400 gpm (90.8 m3/h)	52				
	12	Maximum Inlet High Pressure	1200 psi (82.7 bar)	53				
	13	Maximum Inlet Low Pressure	145 psi (10 bar)	54				
	14	Minimum Discharge Pressure	12 psi (.8 bar)	55				
	15	Filtration Requirement (Nominal)	20 µm	56				
	16			57		Outside Dimensions		Standard
	17			58		Internal Components		Standard
	18			59		Housing Dimensions		Standard
PERFORMANCE	20	Peak Efficiency*	97.8%	61	INSPECTION	Ceramic Dimensions		Standard
	21	Maximum High Pressure Differential*	10.1 psi (.70 bar)	62		Material Certificates		Standard
	22	Maximum Low Pressure Differential*	9.29 psi (.64 bar)	63		Visual		Standard
	23	Maximum Lubrication Flow*	5.0 gpm (1.1 m3/hr)	64		Packing and Crating		Standard
	24	Maximum Rotational Speed*	480 rpm @ 400 gpm	65				
	25	Maximum Salinity Increase at Membranes*	See ERI projections	66				
	26	Noise Per ISO 3744*	Less Than 85 dB(A)	67				
MATERIALS	27	Housing**	GRP	68	SHIPPING WEIGHT AND DIMENSIONS			
	28	Rotor, Sleeve, Endcover Assembly	Ceramic-alumina	69		PX Q400 unit Shipping Dimensions		49.5X18X18 inch 125.7X45.7X45.7cm
	29	Low Pressure Inlet Port Fitting	2507 Super Duplex	70		PX Q400 unit Shipping Weight		370 lbs (167.8kg)
	30	Low Pressure Outlet Port Fitting	2507 Super Duplex	71		Dry PX Q400 unit weight		360 lbs. (164 kg)
	31	High Pressure Inlet Port Fitting	2507 Super Duplex	72		Wet PX Q400 unit weight		407 lbs. (184.6kg)
	32	High Pressure Outlet Port Fitting	2507 Super Duplex	73		Cartridge Shipping Dimensions		14X14X22 inch 35.6X35.6X55.8 cm
	33	Internal Low Pressure Interconnector	Titanium	74		Cartridge Weight		50 lbs. (22.7 kg)
	34	Fasteners/Hardware (non-wetted)	316SS	75		Shipping and Storage Temperature		33°F-120°F (0.6-49°C)
	35	Tension Rod Assembly	2507 Super Duplex	76				
	36	Interconnect Spacers	Noryl™ GFN2F	77				
	37	O-rings	EPDM	78				
PIPING CONNECTIONS	38	Low Pressure Inlet Port Fitting	4" Pipe Grooved-End	79	MISCELLANEOUS			
	39	Low Pressure Outlet Port Fitting		80				
	40	High Pressure Inlet Port Fitting		81				
	41	High Pressure Outlet Port Fitting		82				
	42							
	43							
	44							
*Refer to document 80871-01 & 80008-06 for performance curves and definitions. **Housing designed in accordance with the engineering standards of the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers.								
PRICE: sales@energyrecovery.com								
MANUFACTURER: Energy Recovery Inc			MODEL: PX-Q400					

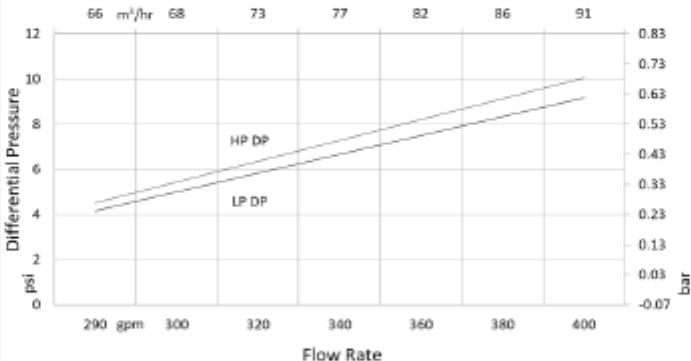
Cliente 		Empreiteiro EPC   		
Projeto nº.	Projeto	Data	Rev.	Pág.
	Sistema de dessalinização na região do Algarve	20/02/2025	01.0	31 de 50
Código AdA AL-ACE-0000-ME-DSH-ROR02		Código ACE AL-INN-0000-ME-DSH-ROR01		

	1717 Doolittle Dr. San Leandro, CA 94577, USA Phone: +1(510)483-7370	ENERGY RECOVERY, INC. PX-Q400	REV	BY	CKD	REVISION	DATE
			00	AKP	CD	Initial Release	Dec 2, 2022
PERFORMANCE CURVES, POSITIVE DISPLACEMENT ENERGY RECOVERY DEVICE		SHEET 1 of 1					
		DOCUMENT NUMBER 80871-01					
		MANUFACTURER ERI					

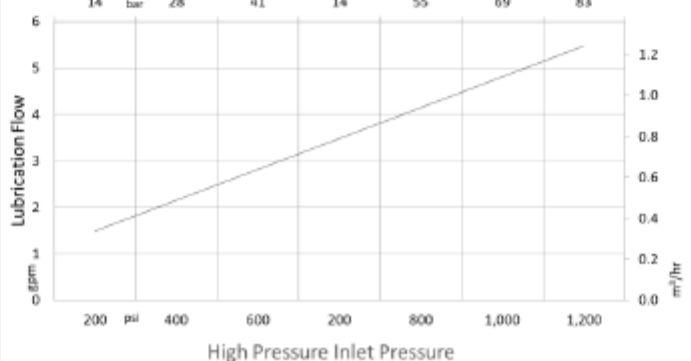
EFFICIENCY AT 1000 psi



DIFFERENTIAL PRESSURE AT 1000 psi



LUBRICATION FLOW AT 400GPM / 90.8 m³/hr



NOTE: SEE ERI DOCUMENT NUMBER 80008-06 FOR DEFINITIONS AND TEST CONDITIONS

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	Energy Recovery, Inc 1717 Doolittle Drive San Leandro CA 94577 USA Tel: +1 510 483 7370	PERFORMANCE CURVES DEFINITIONS, PX-Q400	REV	BY	CKD	REVISION	DATE
			00	AKP	CD	INITIAL RELEASE	12/2/22
		Doc. No.	80008-06				
		Sheet No.	Page 1 of 2				

Efficiency:

Energy transfer efficiency in the Pressure Exchanger (PX Series) unit as calculated with the following equation:

$$Efficiency = \frac{\sum (Pressure \times Flow)_{OUT}}{\sum (Pressure \times Flow)_{IN}} \times 100 \%$$

High Pressure Flow Differential Pressure (HP DP):

The pressure at the high-pressure inlet port of the PX minus the pressure at the high-pressure outlet port of the PX.

Low Pressure Flow Differential Pressure (LP DP):

The pressure at the low-pressure inlet port of the PX minus the pressure at the low-pressure outlet port of the PX.

Lubrication Flow:

The flow rate of high-pressure fluid required to lubricate the PX's hydrodynamic bearing measured as a difference in flow rates according to any of the following equivalent methods:

- Low-pressure feed water to the main high-pressure pump minus the membrane permeate
- High-pressure inlet flow to the PX unit minus the high-pressure outlet flow from the PX unit
- Low-pressure outlet flow from the PX unit minus the low-pressure inlet flow to the PX unit

Minimum Discharge Pressure (MDP):

The minimum allowable pressure at the low-pressure outlet port of the PX unit.

Salinity Increase:

The increase in salinity of the membrane feed with respect to the feed water due to mixing within the PX device. Salinity increase varies with membrane recovery rate. It is calculated with the following equation:

$$SalinityIncrease = \frac{membrane\ feed\ salinity - feedwater\ salinity}{feedwater\ salinity} \times 100 \%$$

Sound:

Sound Level Pressure (dBA) measured at a distance of 1 meter from the PX device

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 energy recovery™	Energy Recovery, Inc 1717 Doolittle Drive San Leandro CA 94577 USA Tel: +1 510 483 7370	PERFORMANCE CURVES DEFINITIONS, PX-Q400		REV	BY	CKD	REVISION	DATE	
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		Doc. No.		80008-06					
		Sheet No.		Page 2 of 2					

PX Device (PX-Q400) Test Conditions:

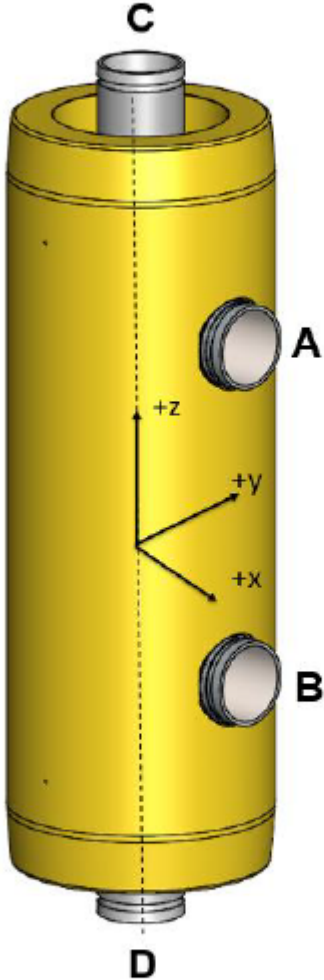
Pressure Exchanger (PX-Q400) performance data collected in ERI's wet test facility in San Leandro, California. Mixing data collected at confidential ERI test facilities and customer site.

- ERI facilities test conditions:

- Process fluid: Municipal Drinking Water: 70 ppm TDS, 68±5 degF / 20 degC (nominal).
- Efficiency and Differential Pressure data collected at 1,000±10 psig / 69 bar high-pressure inlet pressure, 13±1 psig / .89 bar low-pressure outlet pressure with Pressure Exchanger in horizontal orientation.
- Salinity Increase calculated from data collected at 1,000±10 psi / 69 bar high-pressure inlet pressure, 13±1 psig / .89 bar low-pressure inlet pressure at balanced flow (i.e.: LPin flow = HPout flow) and 40% membrane recovery.
- Minimum Discharge Pressure: data collected at 1200±12 psi / 82.7 bar high-pressure inlet pressure and maximum rated flow.
- Lubrication flow curve: data collected at indicated flow rate and high pressure inlet.

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	1717 Doolittle Dr. San Leandro, CA 94577, USA Phone: +1(510)483-7370	ENERGY RECOVERY, INC.	REV	BY	CKD	REVISION	DATE
		PX-Q400	00	AKP	CD	Initial Release	Dec 12, 2022
		SHEET					
		1 of 1					
ALLOWABLE LOADS AND VIBRATION		DOCUMENT NUMBER					
		80887-01					
		MANUFACTURER					
		ERI					



Allowable External Loads, LBS

	Port A, 4"	Port B, 4"	Port C, 4"	Port D, 4"
Fx	6	6	6	6
Fy	6	6	6	6
Fz	6	6	6	6

Note:

- Nozzle Loads represent +/- range of stated value.
 - Example: -6 LBS to +6 LBS
- The PX is not designed to support connecting piping loads, misalignment forces, and bending moments prior to and during operations

Average Vibration, in/s (mm/s)

Port A	Port B	Port C	Port D
0.21	0.15	0.31	0.16
(5.21)	(3.68)	(7.87)	(4.06)

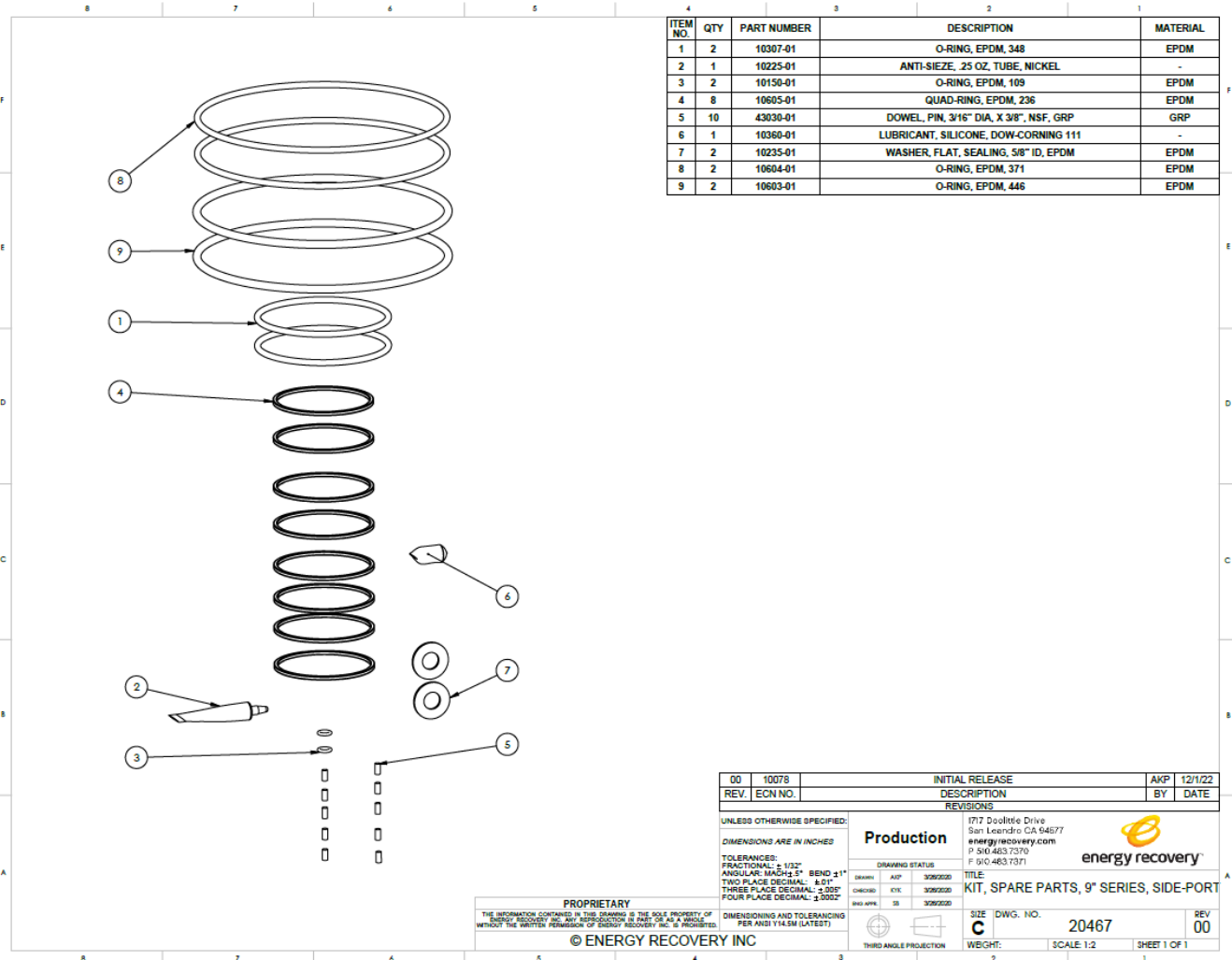
Average Displacement Vibration, mils (microns)

Port A	Port B	Port C	Port D
0.14	0.10	0.21	0.11
(3.45)	(2.44)	(5.33)	(2.79)

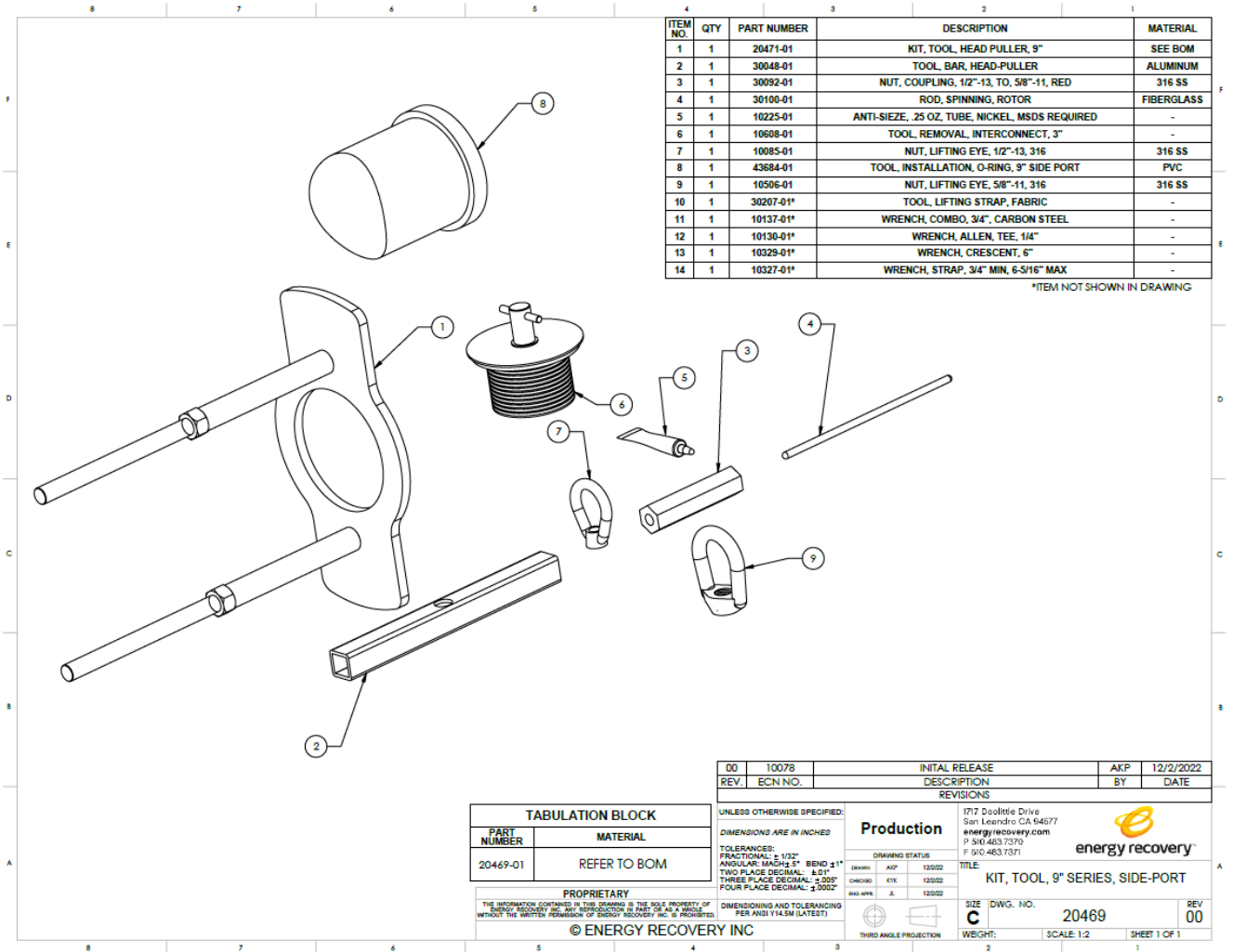
Note:

- Test Conditions: 400 GPM, 1000psi HP in, 18psi LP out, and 73F
- PX Tested in vertical orientation
- Port Description
 - Port A - High Pressure Outlet
 - Port B - High Pressure Inlet
 - Port C - Low Pressure Inlet
 - Port D -Low Pressure Outlet

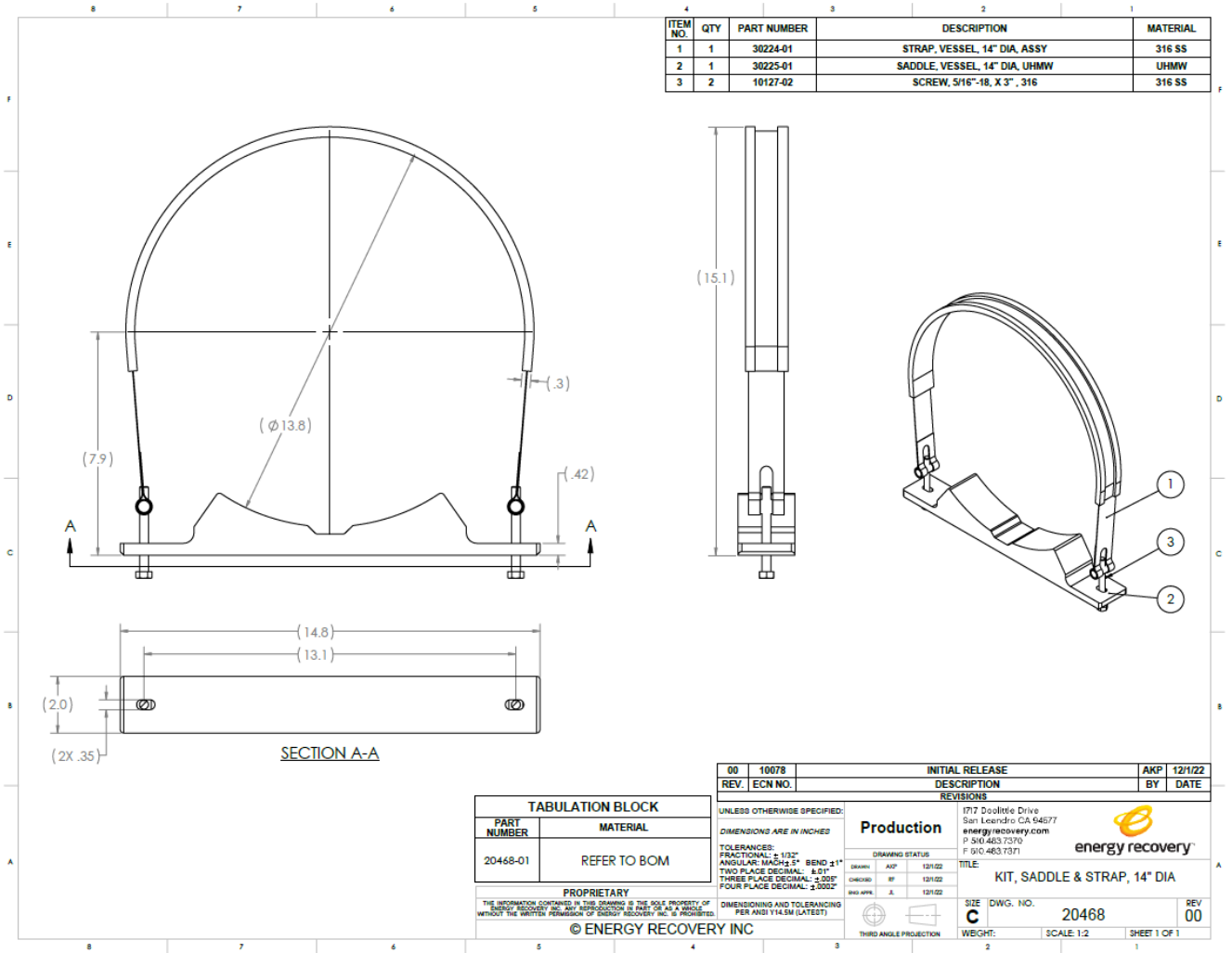
Cliente		Empreiteiro EPC		
		  		
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	Energy Recovery, Inc 1717 Doolittle Drive San Leandro CA 94577 USA Tel: +1 510 483 7370 Fax: +1 510 483 7371	INSPECTION POINTS PROGRAM FOR PRESSURE EXCHANGER		REV	BY	CKD	REVISION	DATE
				00	JMP	RLS	Issued for Review	3/8/07
				01	RLS	JMP	Issued for Distribution	3/19/07
				02	JMP	RLS	Updated	11/28/07
				03	TDR	JGM	Changed Ref doc # from 80009-01 to 80009-02	10/13/10
		Doc. No.	80065-03	04	DN	YR	Updated Format & Detail	05/13/21
		Sheet No.	1 of 2	05	DN	SB	Renumbered items on table & edited columns	08/27/21
				06	RAB	YR	Updated Performance and MC descriptions	10/28/21
				07	RT		Updated standard inspection quantity	12/15/23

Inspection and Test Plan:

1.0 Scope

- The Inspection Test Plan (ITP) is an engineering and quality control document that describes the inspections and tests to be performed on Energy Recovery, Inc. (ERI) Pressure Exchanger (PX) energy recovery devices.
- Inspections are performed in accordance with ERI quality standards.
- Any test required by customer out of the scope of this ITP, shall be carried out at Customer's cost and responsibility and must be approved by ERI prior to the test and documented in a custom ITP.

The ITP includes the following descriptions:

- List of test and quality procedures to be conducted.
- Main equipment to be tested.
- Reference to ERI internal procedures.

2.0 Acceptance and Conditions

- All equipment and materials are to be inspected and tested in accordance with the requirements of this ITP and ERI's quality standards.
- Standard inspection quantity not to exceed 2% of the total order quantity.

3.0 Notification for Witnessed Test

- Upon request, the customer will be notified prior to testing or inspection to allow customer representatives to witness testing activities. Such notification will be issued by ERI by email least 21 days in advance of the testing or inspection. It will include the following details:
 - Date of inspection
 - Inspection place
 - Contact person
 - Inspection or test plan procedure
 - Equipment to be inspected
 - QMS 3020 Witness Test Process

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 energy recovery™	Energy Recovery, Inc 1717 Doolittle Drive San Leandro CA 94577 USA Tel: +1 510 483 7370 Fax: +1 510 483 7371		INSPECTION POINTS PROGRAM FOR PRESSURE EXCHANGER		REV	BY	CKD	REVISION	DATE
					00	JMP	RLS	Issued for Review	3/8/07
					01	RLS	JMP	Issued for Distribution	3/19/07
					02	JMP	RLS	Updated	11/28/07
	Doc. No. 80085-03 Sheet No. 2 of 2		03	TDR	JGM	Changed Ref doc # from 80009-01 to 80009-02	10/13/10		
			04	DN	YR	Updated Format & Detail	05/13/21		
			05	DN	SB	Renumbered items on table & edited columns	08/27/21		
			06	RAB	YR	Updated Performance and MC descriptions	10/28/21		
			07	RT		Updated standard inspection quantity	12/15/23		

Project / Reference:	Customer:	Equipment Type:	Qty
		PX Pressure Exchanger model	

Process No	Process Description / Scope	Specification / Reference Document	Acceptance Criteria	Verification Type		Acceptance			
				ERI	Client / Rep.	ERI Signature	Date	Client / Representative Signature	Date
1	Material Conformance	Supplier MTR ASME BPVC Section X for GRP housing.	ERI Material Spec	R	R				
2	Dimensional and Visual Inspection	ERI drawings	Visual	S	R				
3	Performance Test (Efficiency, cavitation, rotational speed and rotor stall test)	ERI Document Number 80009-02	ERI Internal Quality Specification	S	W				
4	Packaging Inspection	ERI Drawings	Visual	S	W				
5	QC Release	Project-specific compilation of inspection and test results	Certificate of Conformance	R	R				
6	Shipping Authorization	Client shipment release	Customer Conformation	R	H				
Notes:									

Legend of Inspection and Test Verifications:
 R – Review and approval required.
 S – Review and verify compliance with specified document.
 W – Notification required prior to test or inspection to allow for procedure to be witnessed.
 H – Inspection, testing and/or other activities shall be held and shall not proceed without written authorization

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 energy recovery	Energy Recovery, Inc 1717 Doolittle Drive San Leandro CA 94577 USA Tel: +1 510 483 7370 Fax: +1 510 483 7371	FACTORY PERFORMANCE TEST PROCEDURE		REV	BY	CKD	REVISION	DATE	
				00	JMP	ST	INITIAL RELEASE	10/05/09	
				01	RAB	EK	Updated Section 2.5	10/13/15	
		Doc. No.		80009-02					
		Sheet No.		1 of 3					

PURPOSE

To test performance of PX Series Pressure Exchanger (PX) equipment. Unless otherwise noted, all PXs shipped are to be tested according to this procedure.

2.0 GENERAL NOTES

- 2.1 Deviation from test method or procedure must be approved by the Engineer Department and/or the Quality Manager prior to conducting test.
- 2.2 Except as otherwise specified, a signature, initials, or inspectors stamp of the Test Technician on the Test Form (example attached) will indicate that the procedure was completed satisfactorily based on personal observation or objective evidence.
- 2.3 Entries in this test procedure are to be made in ink only. To correct an entry, draw a single line through the error, write the correction, sign and date correction.
- 2.4 Data acquired by the test stand programmable logic controller (PLC) is automatically printed and saved to ERI's testing database. Performance calculations and the final disposition of each PX unit are done automatically using the equations presented in this document.
- 2.5 This procedure refers to the Production Test Stand Process and Instrument Diagram ERI Document Number 80196-01 and the Factory Performance Specifications ERI Document Number 80051.

3.0 PREPARATIONS

- 3.1 The Test Technician shall ensure that the PX device has met all required specifications prior to commencement of the test.
- 3.2 The Test Technician shall brief all pertinent personnel associated with this test on valve locations, electric power arrangements, and emergency shutdown procedures.
- 3.3 The Test Technician shall identify hazards and hazardous areas during the test to all pertinent personnel associated with this test.
- 3.4 The Test Technician shall examine test equipment for damage, excessive leak, and frayed electrical cords.
- 3.5 The Test Technician shall ensure that PX device components have passed all required inspections prior to testing.
- 3.6 The Test Technician shall don appropriate personal protective equipment, including ear and eye protection.

4.0 PROCEDURE

- 4.1 Connect PX to the test stand.
- 4.2 Assure that valves V624, V625 are open for PX testing.
- 4.3 Open valve V623 to fill test stand.
- 4.4 Visually ensure all air is purged from the system.
- 4.5 Close valve V626 and V627.
- 4.6 Close valve V623.
- 4.7 Position Noise Meter at 3.3 feet [1 meter] from PX and turn on Meter.
- 4.8 Attach magnetic sensor of Vibration Meter to PX LP out coupling and turn on Meter.
- 4.9 Select operator on the PLC screen.

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- 4.10 Press "PX test menu" on the Programmable Logic Controller's (PLC's) screen to go to the Operational Set-Points screen.
- 4.11 Select the test to be run on the PX test menu options screen.
- 4.12 Press "run PX test to return to the Main Testing screen.
- 4.13 Enter serial numbers into the serial numbers pane of the screen.
- 4.14 Ensure all operations are in the auto mode on the screen. If the operations are not in the auto mode, convert them to auto mode prior to starting the test.
- 4.15 Reset the E-Stop button(s).
- 4.16 Clear any alarms by pressing the Alarm History button, the Reset Alarms button, and the Back button to return to the Main Testing screen.
- 4.17 Press Start on the screen. The PLC will operate the test stand at the selected flows and pressures in step number 4.12
- 4.18 Enter sound level (dB) at the rated high flow rate in the Noise pane of the screen.
- 4.19 Enter Rotor Speed (cpm) at the rated high flow in the RPM pane of the screen.
- 4.20 Visually check the unit for external leakage.
- 4.21 Press the Test Complete Button when prompted.
- 4.22 The PLC and associated testing programs will record pressure, unit flow, lubrication flow, and temperature data at the specified flows for each unit to be tested.
- 4.23 Enter PASS/FAIL Disposition for the Cavitation Noise Test.
- 4.24 Enter PASS/FAIL Disposition for the 1200 psi Rotor Stall Test.
- 4.25 Enter PASS/FAIL Disposition for the External Leakage Test.
- 4.26 Enter PASS/FAIL Disposition for the Outside Dimension Check.
- 4.27 Press the Test Complete button after steps 4.28-4.31 have been satisfied.
- 4.28 Wait for the system to complete shutdown procedure.
- 4.29 Open V626 and V627 to release pressure from the system.
- 4.30 Close V624 and V625.
- 4.31 Disconnect unit from the test stand.
- 4.32 The PLC and associated testing programs will calculate pressures and efficiency according to:

$$\text{HP OUT. PRESS.} = \text{HP IN PRESS.} - \text{HP DIFF PRESS.}$$

$$\text{LP IN. PRESS.} = \text{LP OUT PRESS.} + \text{LP DIFF PRESS.}$$

$$\text{EFFICIENCY} = 100\% * (\text{F}_{\text{HPout}} * \text{P}_{\text{HPout}} + \text{F}_{\text{LPout}} * \text{P}_{\text{LPout}}) / (\text{F}_{\text{HPin}} * \text{P}_{\text{HPin}} + \text{F}_{\text{LPin}} * \text{P}_{\text{LPin}})$$
- 4.33 The PX unit will be automatically dispositioned by the PLC and associated testing programs based on PX Factory Performance Specifications as listed in ERI Document Number 80051 current revision.

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	Energy Recovery, Inc. 1717 Doolittle Dr. San Leandro, CA 94577, USA Phone: 510-483-7370 Fax: 510-483-7371		PX SINGLE ROTOR FACTORY PERFORMANCE TEST FORM		REV	BY	CHK	REVISION	DATE
					000	LD	SO	As-Built	4/28/2009
					001	EB	AS		9/1/2016
					002	EB	JL		4/20/2018
Doc. No.		80108-01							

PERFORMANCE TEST FORM

Date: **5/17/2018** Time: **11:50:03 AM** Technician: **Cheng Saepanh (CS)**

External Serial #: HC **E1805071**

Internal Serial #: HCI **1805071**

SW Endcover #: **180430003** Brine Endcover #: **180508017**

Model: **PX-Q300**

HP FLOW	LP FLOW	LP IN PRESS.	LP OUT PRESS.	LP DIFF PRESS.	HP IN PRESS.	HP OUT PRESS.	HP DIFF PRESS.	ROTOR SPEED	NOISE*	LUBE FLOW	TEMP	EFFICIENCY
gpm	gpm	psi	psi	psi	psi	psi	psi	cpm	dB	gpm	° F	%
200.0	200.5	17.3	12.2	5.1	1005.2	1000.3	4.9			1.7	66.9	98.2
250.2	250.2	21.1	12.3	8.8	1000.3	991.9	8.4			2.1	66.7	97.5
299.9	300.2	25.4	12.1	13.3	998.1	985.6	12.5	17071	84	2.4	66.9	96.7

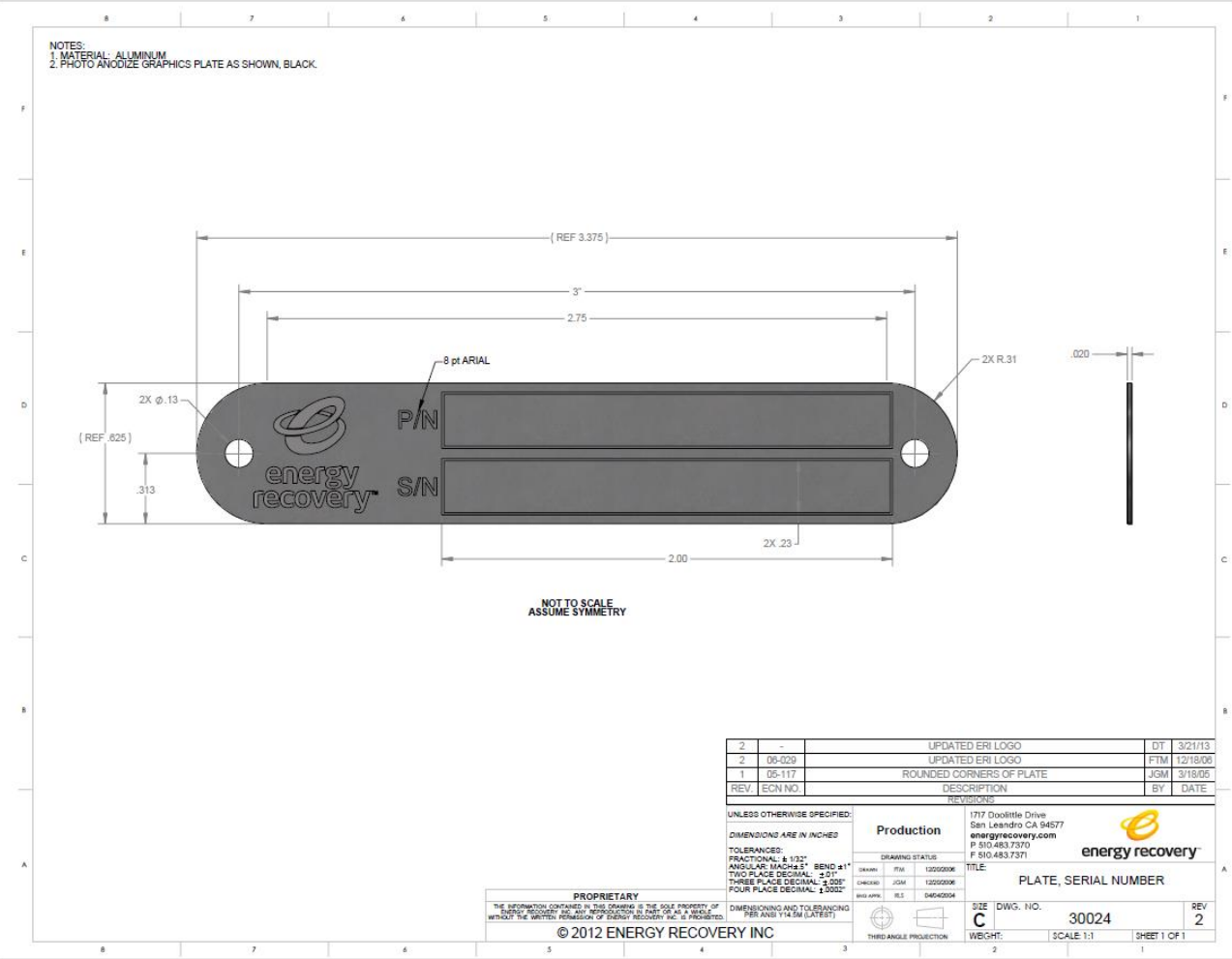
Cavitation Noise Test * ☒ PASS ☐ FAIL
 1200.5 psi Rotor Stall Test ☒ PASS ☐ FAIL
 External Leakage Test ☒ PASS ☐ FAIL
 Visual Inspection ☒ PASS ☐ FAIL

Observations/Notes:
(STEP 1: Passed) (STEP 2: Passed) (STEP 3: Passed)

* This test is not intended to determine sound pressure levels emitted by this equipment. It does not follow the ISO 3744 standard.

Final Disposition ☒ PASS ☐ FAIL

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Technical Bulletin- CE Marking – Applicability to PX

PX

External circulation

JUAN CIFUENTES

REV	ECO	BY	CKD	REVISION	DATE
000	[-]	[RLS]	[IBC]	Initial Release	[08-10-2007]
001	[-]	[TDR]	[JGM]	Updated to add PX 300	[03-17-2010]
002	[10196]	[JC]	[RAB]	Updated to add PX Q400	[06-01-2024]

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This bulletin considers the requirement for CE marking of PX® Pressure Exchanger® energy recovery devices for seawater and brackish water reverse osmosis processes.

CE MARKING APPLICABILITY



The requirements for CE marking for pressure equipment are presented in Directive 2014/68/UE of the European Parliament and of the Council of 15 May 2014 ("the Directive"). The Directive concerns manufacturers of items such as pressurized storage containers, heat exchangers, steam generators, boilers, industrial piping, safety devices and pressure accessories. The article of the Directive that is potentially applicable to PX Pressure Exchanger devices is that for vessels: Article 4, Section 1.a.ii.

Applicability is based upon the type, volume and pressure of the fluid contained in the vessel. PX Pressure Exchanger devices contain non-hazardous seawater or brackish water. The maximum internal volume of the largest PX Pressure Exchanger device currently manufactured by ERII (the PX Q400) including the volume of the nozzles is approximately 20 liters. The specified maximum pressure for which PX Pressure Exchanger devices are designed is 83 bar.

The specified maximum pressure for which the Ultra PX Pressure Exchanger devices are designed is 120 bar, and the internal volume of the largest Ultra PX Pressure Exchanger device currently manufactured by ERII (the PX U250) including the volume of the nozzles is approximately 21 liters.

Based upon these characteristics, the Directive indicates that PX Pressure Exchanger devices "must not bear the CE marking." Therefore, we conclude that CE marking is not applicable to PX Pressure Exchanger and Ultra PX Pressure Exchanger energy recovery devices used for seawater, brackish water, and industrial waste water reverse osmosis processes.

For additional information about PX device, contact Energy Recovery at sales@energyrecovery.com or call +1 (510) 483-7370.

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PX Codes and Standards

Pressure Containing

Housing	ASME BPVC Section X
Housing Ring	ASTM SA351 or SA479
Head	ASME BPVC Section II SB-221
Lock Rings	ASTM SA351 (material)
	ASTM A744 (heat treatment)
Ports	ASTM A790
Coupling Connections	AWWA C-606

Internal, Wetted, Non-pressure containing

Interconnects	ASTM B861
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Miscellaneous Certifications	NSF/ANSI 61, Certificate N-8485
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[Escriba aquí]

Energy Recovery, Inc. | 1717 Doolittle Drive | San Leandro, CA 94577 | +1 (510) 483-7370 | +1 (510) 483-7371 (fax) |
www.energyrecovery.com

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	Energy Recovery, Inc. 1717 Doolittle Dr. San Leandro, CA 94577, USA Phone: 510-483-7370 Fax: 510-483-7371	Pressure Exchanger™ Vessel Paint Data		REV	BY	CKD	REVISION	DATE
				00	JL		Issued for Ref	20 Sep 18
			00	AKP	JL	Added dual units for paint thickness	19 Jan 23	
		Doc. No.	80682-01	01	AKP	JL	Updated per ROPV review	02 Feb 23
	Sheet No.	1 of 1						

Pressure Exchanger™ Vessel Paint

The following is for informational purposes only. Pressure Exchanger™ vessels should only be painted and repaired by ERI approved facilities.

- Clean surface of vessel with cotton cloth and paint thinner.
- Primer coat:
 - Acrylic polyurethane primer
 - 1 Heavy coat
 - 0.25 mm (10 mils) thick, total DFT (*Approximate Thickness*)
- After cure, sand primer with 180 grit sand paper until smooth. Finish with wet sanding 320 grit.
- Base coat:
 - Acrylic polyurethane
 - 1-2 coats
 - 0.025 mm (.98 mils) thick, total DFT (*Approximate Thickness*)
 - RAL1003, yellow
- Cure at 80°C (176°F) for 1 hour.
- After Cure, move to outside for 30 minutes and then sand with 320 grit.
- Top coat:
 - Acrylic polyurethane
 - 1-2 coats
 - 0.025 mm (.98 mils) thick, total DFT (*Approximate Thickness*)
 - RAL1003, yellow
- Cure at 80°C (176°F) for 1 hour.
- After Cure, move to outside for 30 minutes and then sand with 320 grit.
- Finish Coat:
 - Acrylic polyurethane
 - 1-2 coats
 - 0.025 mm (.98 mils) thick, total DFT (*Approximate Thickness*)
 - RAL1003, yellow
- Cure at 80°C (176°F) for 1 hour.
- Check color against standard RAL1003 paint chip.

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CUSTOMER REFERENCE LIST



MPD Reference List



Q3 - 2024



Worldwide



All Products



energy recovery™

YEAR	COUNTRY	CUSTOMER	CAPACITY (M3/DAY)	PROJECT NAME	PRODUCT	Application	Industry
2024	Morocco	Acciona	822,000	Casablanca desal plant	PX-Q400	Seawater RO	Municipal
2024	United Arab Emirates	SIDEM	820,000	Hassyan SWRO	PX-Q400	Seawater RO	Municipal
2024	Saudi Arabia	WETICO	600,000	Rasigh 4	PX-Q400	Seawater RO	Municipal
2024	United Arab Emirates	Orascom Construction, Metito L.L.C JV	520,000	Abu Dhabi ADNOC - NF	PX-Q300	Seawater RO	Municipal
2024	India	VA TECH WASAG	450,000	Perur SWRO	PX-Q300	Seawater RO	Municipal
2024	United Arab Emirates	GS INIMA ENVIRONMENT, S.A.U	360,000	Shuweihat 4 IWP	PX-Q400	Seawater RO	Municipal
2024	Oman	GS INIMA ENVIRONMENT, S.A.U	300,000	Shuqrah 3	PX-Q300	Seawater RO	Municipal
2024	Morocco	MINGA Water	346,000	Jorf Lasfar Wave 2	PX-Q400	Seawater RO	Municipal
2024	Australia	Alkimos Seawater Joint Venture (ACA, AGUA & JACOBS)	150,000	Alkimos Desalination Plant	PX-Q400	Seawater RO	Municipal
2024	Spain	Sacyr Water	120,000	Carboneras SWRO	PX-Q300	Seawater RO	Municipal
2024	United Arab Emirates	Tecton	100,000	Floating Barge	PX-Q300	Seawater RO	Municipal
2024	India	AQUATECH INTERNATIONAL CORPORATION	100,000	Mandla Desal Plant	PX-Q300	Seawater RO	Municipal
2024	Saudi Arabia	Tecton	95,400	Jafurah Gas Oil field	PX-Q300	Seawater RO	Oil and Gas
2024	Morocco	Fisla Italmimpianti	92,000	Dakhla SWRO	PX-Q400	Seawater RO	Agriculture
2024	Chile	IDE WATER TECHNOLOGIES LTD	73,000	Radomiro Tomic Codeico	PX-Q300	Seawater RO	Municipal
2024	India	AQUATECH INTERNATIONAL CORPORATION	70,000	Bhavnagar Desal Plant	PX-Q300	Seawater RO	Municipal
2024	India	AQUATECH INTERNATIONAL CORPORATION	70,000	Dwarka Desal plant	PX-Q300	Seawater RO	Municipal
2024	Morocco	SYCHEM SA	60,000	Wave 2	PX-Q300	Seawater RO	Municipal
2024	Morocco	Ion Exchange (India) Ltd.	60,000	Wave 3	PX-Q400	Seawater RO	Municipal
2024	Kazakhstan	SNK	50,000	Kindrei SWRO	PX-Q300	Seawater RO	Municipal
2024	China	Qingdao Ankixin Electromechanical Equipment Co., Ltd	50,000	Tangshan Port SWRO	PX-Q300	Seawater RO	Municipal
2024	Morocco	SYCHEM SA	30,000	Wave 3 Extension 1	PX-Q300	Seawater RO	Municipal
2024	Morocco	SYCHEM SA	30,000	Wave 3 Extension 2	PX-Q300	Seawater RO	Municipal
2023	Saudi Arabia	Doosan Enerbility Co., Ltd.	650,000	Shoaliba III	PX-Q300	Seawater RO	Municipal
2023	United Arab Emirates	SIDEM	570,000	Mirfa 2 IWP	PX-Q300	Seawater RO	Municipal
2023	Israel	IDE TECHNOLOGIES LTD.	400,000	Western Galilee	PX-Q300	Seawater RO	Municipal
2023	Qatar	Acciona Agua	377,000	North Field Expansion	PX-Q300	Seawater RO	Oil and Gas
2023	Algeria	WETICO	300,000	Bejaia SWRO	PX-Q300	Seawater RO	Municipal
2023	Algeria	WETICO	300,000	Cap Djinet SWRO	PX-Q300	Seawater RO	Municipal
2023	Algeria	WETICO	300,000	El Tarf SWRO	PX-Q300	Seawater RO	Municipal
2023	Algeria	Metito (Overseas) Limited	300,000	Fouka SWRO	PX-Q300	Seawater RO	Municipal
2023	Algeria	HANGZHOU WATER TREATMENT TECHNOLOGY DEVELOPMENT	300,000	Cap Blanc SWRO	PX-Q300	Seawater RO	Municipal
2023	Chile	ACCIONA AGUA S.A.U.	114,000	Colihueco SWRO	PX-Q300	Seawater RO	Mining
2023	South Korea	GS INIMA ENVIRONMENT, S.A.U	110,000	K-Water	PX-Q300	Seawater RO	Municipal
2023	Chile	IDE WATER TECHNOLOGIES LTD	86,000	Angio America	PX-Q300	Seawater RO	Mining
2023	China	Qingdao Ankixin Electromechanical Equipment Co., Ltd	75,000	Tianjin Nangang SWRO	PX-Q300	Seawater RO	Municipal
2023	China	SUEZ Infrastructure Company Limited (SUZ Hong Kong)	74,000	Pengtai Wanhua SWRO	PX-Q300	Seawater RO	Municipal
2023	Singapore	VA TECH WASAG	50,000	Marmelès SWRO	PX-Q300	Seawater RO	Municipal
2023	India	VA Tech Wabag Pune	50,000	Reliance Jamnagar Expansion	PX-Q300	Seawater RO	Oil and Gas
2023	China	QINGDAO FTZ GEM-IN INTERNATIONAL	33,000	Shandong Lubei	PX-Q300	Seawater RO	Municipal
2022	Saudi Arabia	Metito (Overseas) Limited	998,000	JUBAIL II	PX-Q300	Seawater RO	Municipal
2022	Saudi Arabia	ACCIONA AGUA S.A.	560,000	Jubail 3B	PX-Q300	Seawater RO	Municipal
2022	Saudi Arabia	Doosan Heavy Industries & Construction CO, LTD.	450,000	Yanbu 4	PX-Q300	Seawater RO	Municipal
2022	India	CobraTecton Pvt Ltd	150,000	Nemmeli II	PX-Q300	Seawater RO	Municipal
2022	Chile	IDE WATER TECHNOLOGIES LTD	144,000	Minera Escondido - Phase 3	PX-Q300	Seawater RO	Municipal
2022	Tsinghai Kwan O	ACCIONA AGUA S.A.U.	144,000	Tseung Kwan O	PX-Q300	Seawater RO	Municipal
2022	Tunisia	Metito (Overseas) Limited	100,000	SFAK	PX-Q300	Seawater RO	Municipal
2022	Oman	Fisla & GS INIMA JV	100,000	Barka V	PX-Q300	Seawater RO	Municipal
2022	Algeria	Metito (Overseas) Limited	80,000	CORSO	PX-Q300	Seawater RO	Municipal
2022	China	Qingdao Ankixin Electromechanical Equipment Co., Ltd	80,000	Yulong Petrochemical SWRO	PX-Q300	Seawater RO	Chemical
2022	Egypt	TAM ENVIRONMENTAL SERVICES	65,000	East Matrouh	PX-Q300	Seawater RO	Municipal
2022	Spain	AQUALIA INTECH S.A.	60,000	Mar de Alboran	PX-Q300	Seawater RO	Agriculture
2022	Algeria	MES (Mechanical Electrical Services)	60,000	El Marsa SWRO	PX-Q300	Seawater RO	Municipal
2021	Saudi Arabia	Rawafid Industrial Co.Ltd	600,000	Shoaliba 2	PX-Q300	Seawater RO	Municipal
2021	Saudi Arabia	Abengoa	600,000	Jubail 3A	PX-Q300	Seawater RO	Municipal
2021	Israel	IDE PROJECTS LTD	572,000	Soreq 2	PX-Q300	Seawater RO	Municipal
2021	Saudi Arabia	Metito (Overseas) Limited	420,000	Jubail I	PX-Q300	Seawater RO	Municipal
2021	Saudi Arabia	ACCIONA AGUA S.A.	400,000	Shuqaiq 4	PX-Q300	Seawater RO	Municipal
2021	India	Larsen & Toubro - Tecton JV	108,205	Dahaj desalination plant	PX-Q300	Seawater RO	Municipal
2021	China	QINGDAO FTZ GEM-IN INTERNATIONAL	100,000	Qingdao Befez	PX-Q300	Seawater RO	Municipal
2021	Taiwan	IDE PROJECTS LTD	100,000	Taiwan Formosa SWRO plant	PX-Q300	Seawater RO	Municipal
2021	Indonesia	Aquatech Systems (Asia) Pvt. Ltd	98,820	Pertamina	PX-Q300	Seawater RO	Oil and Gas
2021	China	QINGDAO FTZ GEM-IN INTERNATIONAL	50,000	Tangshan Port SWRO	PX-Q300	Seawater RO	Municipal
2021	Tunisia	VA Tech Wabag Pune	50,000	Zaaret	PX-Q300	Seawater RO	Municipal
2020	United Arab Emirates	Abengoa	938,000	Taweeleh SWRO plant	PX-Q300	Seawater RO	Municipal
2020	Saudi Arabia	ACCIONA AGUA S.A.	700,000	Khobar 2 MSF replacement	PX-Q300	Seawater RO	Municipal
2020	United Arab Emirates	SIDEM	681,600	Umm Al Qwain	PX-Q300	Seawater RO	Municipal
2020	Saudi Arabia	Abengoa	670,000	Rasigh III	PX-Q300	Seawater RO	Power Plant
2020	Qatar	ACCIONA AGUA S.A.	364,000	Facility D Expansion(Umm Al Houf)	PX-Q300	Seawater RO	Oil and Gas
2020	Morocco	Abelinas (EPC)	275,000	Ohtouka SWRO	PX-Q300	Seawater RO	Municipal
2020	Saudi Arabia	Metito (Overseas) Limited	151,200	Barge 3 x 50,000 m3/day	PX-Q300	Seawater RO	Marine - Commercial
2020	China	QINGDAO FTZ GEM-IN INTERNATIONAL	141,120	Zhejiang Longsheng	PX-Q300	Seawater RO	Chemical
2020	Chile	IDE PROJECTS LTD	125,000	Miners Escondido retrofit	PX-Q300	Seawater RO	Mining
2020	Egypt	METITTO WATER TREATMENT SAE	100,000	EL-Areesh SWRO	PX-Q300	Seawater RO	Municipal
2020	Egypt	RWL Water Middle East FZE	40,500	Mansoura SWRO	PX-Q300	Seawater RO	Municipal
2020	Chile	IDE PROJECTS LTD	25,000	Miners Escondido retrofit - first phase	PX-Q300	Seawater RO	Mining
2019	Saudi Arabia	ACCIONA AGUA S.A.	450,000	Shuqaiq 3	PX-Q300	Seawater RO	Municipal
2019	Bahrain	SIDEM	340,000	AL Dur 2	PX-Q300	Seawater RO	Municipal
2019	Saudi Arabia	Rawafid Industrial Co.Ltd	238,000	Satellite Project	PX-Q300	Seawater RO	Municipal
2019	Saudi Arabia	ACCIONA AGUA S.A.	235,020	South Dhahran	PX-Q300	Seawater RO	Municipal
2019	United Arab Emirates	Acciona - Besix JV	210,816	Jebel Ali Power & Desalination complex	PX-Q300	Seawater RO	Municipal
2019	Saudi Arabia	Metito (Overseas) Limited	153,840	DUBA SWCC	PX-Q300	Seawater RO	Municipal
2019	Singapore	IDE TECHNOLOGIES LTD.	136,000	Jurong Island	PX-Q300	Seawater RO	Municipal
2019	Oman	UTE Abelmia Fisla Salalah	110,000	Salalah OPWP	PX-Q300	Seawater RO	Municipal
2019	Chile	IDE PROJECTS LTD	102,300	Quebrada Blanca	PX-Q300	Seawater RO	Mining
2019	Chile	TEDAGUA	87,000	Spence - BHP Billinton (BOOT)	PX-Q300	Seawater RO	Mining

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2019	Egypt	TAM ENVIRONMENTAL SERVICES	80,000	Ain Sokhna SWRO	FX-Q300	Seawater RO	Municipal
2019	Oman	ACCIONA AGUA S.A.	80,000	Sharqiyah	FX-Q300	Seawater RO	Municipal
2019	Tunisia	Abengoa	50,000	Sousse	FX-Q300	Seawater RO	Municipal
2019	China	QINGDAO FTZ GEM-IN INTERNATIONAL	33,340	Shandong Lubei	FX-Q300	Seawater RO	Municipal
2019	China	QINGDAO FTZ GEM-IN INTERNATIONAL	17,642	Zhejiang Longsheng	FX-Q300	Seawater RO	Chemical
2018	Saudi Arabia	ACCIONA AGUA S.A.	400,000	Shoelba 4	FX-Q300	Seawater RO	Municipal
2018	Saudi Arabia	UTE Abelma Fala Shualbah	278,000	Shoelbah III exp II	FX-Q300	Seawater RO	Power Plant
2018	Singapore	KEPPEL SEGHERS ENG. SINGAPORE PTE	160,000	Marine East Desalination Plant	FX-Q300	Seawater RO	Municipal
2018	Egypt	Metito (Overseas) Limited	150,000	East Port Said SWRO	FX-Q300	Seawater RO	Municipal
2018	United Arab Emirates	TEGASUA	121,968	Ras Al Khaimah	FX-Q300	Seawater RO	Municipal
2018	Egypt	TAM ENVIRONMENTAL SERVICES	105,000	Ain Sokhna SWRO	FX-Q300	Seawater RO	Municipal
2018	Saudi Arabia	Metito (Overseas) Limited	32,000	KAEK King Abdullah Economic City	FX-Q300	Seawater RO	Hospitality
2018	China	QINGDAO FTZ GEM-IN INTERNATIONAL	25,000	Hebei Fengguo SWRO	FX-Q300	Seawater RO	Municipal
2017	Kuwait	ACCIONA AGUA S.A.	284,736	Doha SWRO	FX-Q300	Seawater RO	Municipal
2017	Egypt	AQUALIA INFRASTRUCTURAS S.A.	150,000	El Alamein SWRO	FX-Q300	Seawater RO	Municipal
2017	Egypt	METITO WATER TREATMENT SAE	150,000	El Gheila SWRO	FX-Q300	Seawater RO	Municipal
2017	China	HANSHOU WATER TREATMENT TECHNOLOGY DEVELOPMENT	68,200	Zhejiang Longsheng	FX-Q300	Seawater RO	Chemical
2017	Saudi Arabia	VA Tech Wabag Pune	62,250	JAZAN Economic city	FX-Q300	Seawater RO	Hospitality
2017	Spain	CADAGUA S.A.	72,000	Valdientisco Retrofit	FX-Q300	Seawater RO	Municipal
2017	India	BGR ENERGY SYSTEMS LIMITED	84,200	Sri Damodaran TPS Ash Handling Water	FX-Q300	Seawater RO	Power Plant
2016	Oman	SADYT, S.A.	250,000	SOHAR	FX-Q300	Seawater RO	Municipal
2016	Singapore	TEGASUA	153,000	Tuas III	FX-Q300	Seawater RO	Municipal
2016	China	QINGDAO FTZ GEM-IN INTERNATIONAL	106,872	Dongjiekou Jiaonan	FX-Q300	Seawater RO	Municipal
2016	Saudi Arabia	Advanced Water Technology & Rawafid Industrial Co Ltd	73,152	Al Khafji Soier	FX-Q300	Seawater RO	Municipal
2016	Saudi Arabia	AES ARABIA LIMITED	68,000	JAZAN SWRO Plant	FX-Q300	Seawater RO	Chemical
2016	Tunisia	U.T.E. GROUPEMENT SOLIDAIRE JERBA	50,250	Djerba	FX-Q300	Seawater RO	Municipal
2016	China	BEIJING SINOR WATER TECHNOLOGY	50,000	Cangzhou New Bohai	FX-Q300	Seawater RO	Municipal
2016	India	VA TECH WABAG INTERNATIONAL BUSINESS GROUP	26,640	Reliance Jamnagar	FX-Q300	Seawater RO	Oil and Gas
2015	Qatar	ACCIONA AGUA S.A.U.	336,000	Facility D (Umm Al Houl Power and Water project	FX-Q300	Seawater RO	Oil and Gas
2015	Oman	HYFLUX - HYDROCHEM (S) PTE LTD	223,080	Qurayyat	FX-Q300	Seawater RO	Municipal
2015	Qatar	ACCIONA AGUA S.A.U.	200,200	RAS ABU FONTAS A3	FX-Q300	Seawater RO	Power Plant
2015	United Arab Emirates	DEGREMONT - HEADQUARTER	161,710	Mirfa	FX-Q300	Seawater RO	Municipal
2015	Oman	VEOLIA WATER SOLUTIONS (MAIN ACCOUNT)	60,960	Sur	FX-Q300	Seawater RO	Municipal
2015	United States	BIWATER AEWT	37,860	San Antonio Water BWRO	AT-1500 Duplex	Brackish Water RO	Municipal
2015	China	QINGDAO FTZ GEM-IN INTERNATIONAL	22,500	Cangzhou New Bohai	FX-Q300	Seawater RO	Municipal
2014	India	IDE TECHNOLOGIES LTD.	188,343	Reliance Jamnagar 170,000 cmd	FX-Q300	Seawater RO	Oil and Gas
2014	Trinidad and Tobago	HYFLUX - HYDROCHEM (S) PTE LTD	50,004	Beetham WRP	LPT-1000 Duplex	Brackish Water RO	Municipal
2013	Oman	CADAGUA S.A.	248,024	Al Ghursh	FX-Q300	Seawater RO	Municipal
2013	Saudi Arabia	VEOLIA WATER SOLUTIONS (MAIN ACCOUNT)	224,884	Sadara Petro	FX-Q300	Seawater RO	Chemical
2013	United States	IDE TECHNOLOGIES LTD.	189,000	Carlsbad	FX-Q300	Seawater RO	Municipal
2013	United Arab Emirates	ACCIONA AGUA S.A.U.	146,880	Fujairah 1	FX-Q300	Seawater RO	Municipal
2013	Saudi Arabia	ACCIONA AGUA S.A.U.	129,816	Jubail 4 - MARAFIQ	FX-Q300	Seawater RO	Municipal
2013	Spain	CADAGUA S.A.	121,000	VALDELENTISCO RETROFIT	FX-Q300	Seawater RO	Municipal
2013	Ghana	BEFESA WATER (ABEIMA)	60,600	Nungua, Accra SWRO Plant Ghana	FX-300	Seawater RO	Municipal
2013	Chile	ACCIONA AGUA S.A.U.	17,480	CAP Phase II - Punta Totoralillo	FX-Q300	Seawater RO	Mining
2012	Israel	SADYT, S.A.	417,600	Achdod	FX-Q300	Seawater RO	Municipal
2012	Australia	SADYT, S.A.	165,600	Perth II - expansion	FX-260	Seawater RO	Municipal
2012	Israel	GES-GLOBAL ENVIRONMENTAL SOLUTIONS	142,518	Palmachim Expansion	FX-Q260	Seawater RO	Municipal
2012	Morocco	CADAGUA S.A.	96,684	Jorf Lasfar	FX-Q300	Seawater RO	Mining
2012	United Arab Emirates	Aquatech Systems (Asia) Pvt. Ltd	68,400	Ghailiah	FX-260	Seawater RO	Municipal
2012	Israel	GES-GLOBAL ENVIRONMENTAL SOLUTIONS	60,000	Palmachim Expansion	FX-Q260	Seawater RO	Municipal
2012	Oman	BEFESA WATER (ABEIMA)	50,000	Barka I	FX-300	Seawater RO	Municipal
2012	Chile	ACCIONA AGUA S.A.U.	17,280	CAP - Punta Totoralillo	FX-Q300	Seawater RO	Mining
2011	India	IDE TECHNOLOGIES LTD.	126,000	Nemmel	FX-220	Seawater RO	Municipal
2011	Cyprus	IDE TECHNOLOGIES LTD.	60,000	Vasilikos	FX-260	Seawater RO	Municipal
2011	Spain	UTE DESALADORA MARINA BAJA	50,000	Marina Baja	FX-260	Seawater RO	Municipal
2010	Australia	THIES DEGREMONT JOINT VENTURE	504,000	Victoria Desalination Plant - Melbourne	FX-260	Seawater RO	Municipal
2010	Algeria	HYDROCHEM (S) PTE LTD	500,000	Magtaa	AT-7800	Seawater RO	Municipal
2010	Australia	ACCIONA AGUA S.A.U.	150,000	Adelaide Desalination Project	FX-260	Seawater RO	Municipal
2010	China	UTE DESALADORA QINGDAO (Befesa)	100,000	Qingdao	FX-260	Seawater RO	Municipal
2010	Spain	UTE IDAM MOINGOA (Inima)	60,000	IDAM Moncofe	FX-260	Seawater RO	Municipal
2010	Spain	UTE DESALADORA OROPESA (Technicas Reunidas)	50,000	IDAM Oropesa del Mar	FX-300	Seawater RO	Municipal
2009	Algeria	BEFESA AGUA S.A.U.	200,000	Tenas	FX-260	Seawater RO	Municipal
2009	Algeria	HYFLUX - HYDROCHEM (S) PTE LTD	200,000	Thiemacen Souk Thia	FX-220	Seawater RO	Municipal
2009	Algeria	UTE MOSTAGANEM (Inima/Aqualis)	200,000	IDAM MOSTAGANEM, Argelia	FX-220	Seawater RO	Municipal
2009	Australia	ACCIONA AGUA S.A.U.	150,000	Adelaide Desalination Project	FX-260	Seawater RO	Municipal
2009	Australia	Sothern Sewater Joint Venture (Valoriza /Sadyt)	137,000	Perth II	FX-260	Seawater RO	Municipal
2009	Algeria	Cap D'Jinet UTE (Inima/Aqualis)	90,000	Cap D'Jinet	FX-260	Seawater RO	Municipal
2009	Venezuela	ACCIONA AGUA S.A.U.	74,000	Desalinizadora CRP Paraguana, Venezuela	FX-260	Seawater RO	Oil and Gas
2009	Israel	IDE TECHNOLOGIES LTD.	40,000	Hadera Expansion I	FX-260	Seawater RO	Municipal
2008	Israel	IDE TECHNOLOGIES LTD.	388,368	Hadera	FX-220	Seawater RO	Municipal
2008	Algeria	UTE DESALADORA HONAINA	200,000	Honaine Desalination Plant	FX-220	Seawater RO	Municipal
2008	United Arab Emirates	AQUA ENGINEERING AUSTRIA GMBH	200,000	Hamriyah Power Station	FX-260	Seawater RO	Power Plant
2008	Spain	UTE DESSALADORA BARCELONA (Degremont)	200,000	Desaladora Barcelona	FX-220	Seawater RO	Municipal
2008	Australia	IDE TECHNOLOGIES LTD.	140,004	Cape Preston	FX-220	Seawater RO	Mining
2008	Kuwait	ACCIONA AGUA S.A.	140,000	Shuwaikh	FX-220	Seawater RO	Municipal
2008	Algeria	FOUKA EPC UTE (Acciona)	121,248	Algeria Zeralda - Fouka	FX-220	Seawater RO	Municipal
2008	China	HYFLUX - HYDROCHEM (S) PTE LTD	100,000	Tianjin Degan Desalination Plant	FX-220	Seawater RO	Industrial
2008	Spain	Bajo Almazora Desalination Plant U.T.E. (Befesa/Aqualis)	65,000	Bajo Almazora	FX-220	Seawater RO	Municipal
2008	Spain	AMPLIACIÓN I.T.A.M. TORDERA U.T.E. (Befesa/Aqualis)	64,000	Desaladora de La Tordera	FX-260	Seawater RO	Municipal
2008	Namibia	KEYPLAN (PTY) LTD	63,000	Ursmin -Swakopmund	FX-220	Seawater RO	Mining
2008	Cyprus	IDE TECHNOLOGIES LTD.	20,000	Larnaca	FX-260	Seawater RO	Municipal
2007	Spain	UTE IDAM TORREVIEJA (Acciona)	240,000	IDAM Torrevieja	FX-220	Seawater RO	Irrigation
2007	Algeria	GEIDA - UTE DESALADORA BENI SAF	200,000	Beni Saf Desalination Plant	FX-220	Seawater RO	Municipal
2007	Saudi Arabia	Dossan Heavy Industries & Construction CO. LTD.	150,000	Shualbah III IWPP Expansion RO Plant	FX-220	Seawater RO	Municipal
2007	India	UTE DESALADORA CHENNAI (Befesa)	100,000	Chennai Minjur	FX-220	Seawater RO	Municipal
2007	Spain	UTE IDAM ALICANTE II (Inima)	66,500	Alicante II	FX-220	Seawater RO	Municipal
2006	Algeria	GEIDA - UTE DESALADORA SKIKDA CONSTRUCCION	100,000	Skikda Desalination Plant	FX-220	Seawater RO	Municipal
2006	Spain	TEGASUA	50,050	IDAM Escombrers (Cartagena)	FX-220	Seawater RO	Industrial
2005	Algeria	GE WATER & PROCESS TECHNOLOGIES	200,000	Hammis Seawater Desalination Plant	FX-220	Seawater RO	Municipal
2005	Australia	MULTIFLEX DEGREMONT J.V.	140,000	Perth I - Seawater Desalination Plant	FX-220	Seawater RO	Municipal