



Hydra-Cell®

Seal-less Pump Technology

**Reverse Osmosis,
Nano Filtration and Ultra Filtration**

Simplicity - Reliability



Hydra-Cell® Reverse Osmosis Pumps – High reliability,

Hydra-Cell® pumps are used in a wide variety of applications.



Sea and high brackish water desalination



Mobile drinking water unit



Offshore and shipboard desalination



Pharmaceutical, and laboratory process water purification



- Reverse Osmosis

compact, seal-less and energy efficient design



Food and beverage
concentration and
process water
purification



Remote solar
powered drinking
water production



Chemical and
pharmaceutical plant
waste stream reduction
and salt solution
concentration

- Nano Filtration
- Ultra Filtration

Hydra-Cell® Reverse Osmosis Pumps

Seal-less pumps for long life, high reliability and low total life-cycle costs



High efficiency, high pressure pumps for seawater and high brackish water desalination, process water conditioning and purification, waste water reduction, solvent/acid recovery and solute concentration.

• Reverse Osmosis • Nano Filtration • Ultra Filtration

Typical Liquids Pumped	Challenges in Pumping	The Hydra-Cell® Advantage
Chemicals... acids, salt solutions and proprietary chemicals	• Potentially corrosive • Leaks can be harmful	• Corrosion resistant liquid head materials available • 100% Sealed unit prevents leaks
Beverages, Juices and Foodstuffs... for concentration	• Solids may crystallise and cause wear • May contain difficult to pump solids that can be abrasive • Potentially corrosive	• Seal-less design can pump solids up to 500 µm dia. • Seal-less pump chamber for high reliability
Brakish Water... 18 – 25k TDS	• Solid particles may be present from poorly attended pre-filtration • Remote units may run dry	• Seal-less design can pump solids up to 500 µm dia. • Run-dry indefinitely

Typical Liquids Pumped	Challenges in Pumping	The Hydra-Cell® Advantage
Seawater... 30 – 65k TDS	• Corrosive. Corrosion increases with increase in salt content • Salt crystallization can occur on internal surfaces when pump is not in operation. Crystallised solids can cause premature wear of dynamic seals or tight tolerances • Non-lubricating • Raw feed water contains solids which may get through pre-filtration, causing problems with pumps with dynamic seals and tight tolerances in the pumped liquid • Poorly maintained pre-filtration can cause high pressure pumps to run dry	• Corrosion resistant liquid head materials available • No tight tolerances to be damaged by salt crystals • No dynamic seals to wear • No need for lubrication from pumped liquid
Waste Solvent Streams... mixture of water and a range of solvents	• May be corrosive and non-lubricating	• Corrosion resistant liquid head materials available • No need for lubrication from pumped liquid
Waste Water Streams... from food and beverage process	• Undissolved solids can be abrasive / non-lubricating / aggressive	• Seal-less design can pump solids up to 1.5mm dia.



Hydra-Cell® advantages

Designed for 24/7 continuous use, Hydra-Cell® Seal-less Pumps are robust, reliable, efficient and highly tolerant of operator error.

These positive displacement pumps are used extensively in a wide variety of reverse osmosis applications where their high reliability, high efficiency and outstanding controllability are valued greatly.

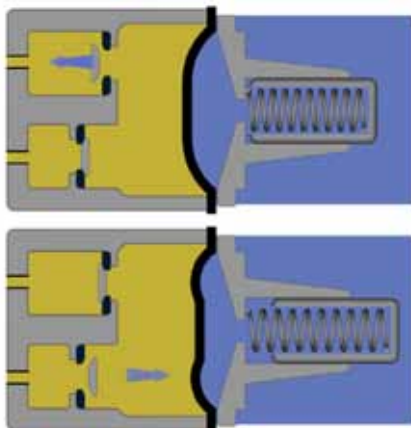


Pharmaceutical process plant –
RO treatment of waste streams

High Reliability... low maintenance

Having **No Dynamic Seals** means high reliability.

- Runs dry indefinitely
- No seals to wear and leak
- No tight tolerances that could be susceptible to corrosion or damaged by particles
- Pumps liquids with viscosities from 0.01 to 6000 cSt
- Pumps liquids with up to 1.5mm dia. particulate matter
- No 'drop off' in performance due to seal wear



High efficiencies

- A true positive-displacement pump, Hydra-Cell® is one of the most efficient RO pumps available in the market

Reduced power usage and cost.

Pump Flow rate m ³ /hr	Discharge Pressure (bar)	Pump Power use (kW)
7.2	80	19.2
4	70	9.5
1.5	80	4.1
1.0	80	2.74

With ERI - energy recovery device

	Pump Flow rate m ³ /hr	Discharge Pressure (bar)	Pump Power use (kW)
G25 + PX - 30S ERI	10.4	70	11.8
G35 + PX - 70S ERI	18.2	70	22.3

Constant flow rate... independent of pressure

- An increase in salt concentration results in an increase in osmotic pressure. Hydra-Cell®'s controllable flow rate means that efficiencies and yields can be maintained if feed water TDS increases, especially important in bore hole applications

Wide range of operating pressures

Discharge Pressure Range		Inlet Pressure Range	
Minimum	Maximum	Minimum	Maximum
0 bar	70, 80 or 172 bar (Model dependent)	-0.3 bar	17 or 34 bar (Model dependent)

Ultimate controllability ►

- Hydra-Cell® Pumps exhibit a linear relationship between pump shaft speed and flow rate better than +/- 3%
- The speed of the pump can be adjusted from 10 rpm to 1500 rpm (or 1000 rpm depending on model) for accurate flow control

Energy saving

- Very economical to run compared with centrifugal pumps
- Smaller, more compact motors required

Compared with multi-stage centrifugal pumping water at 20 bar:

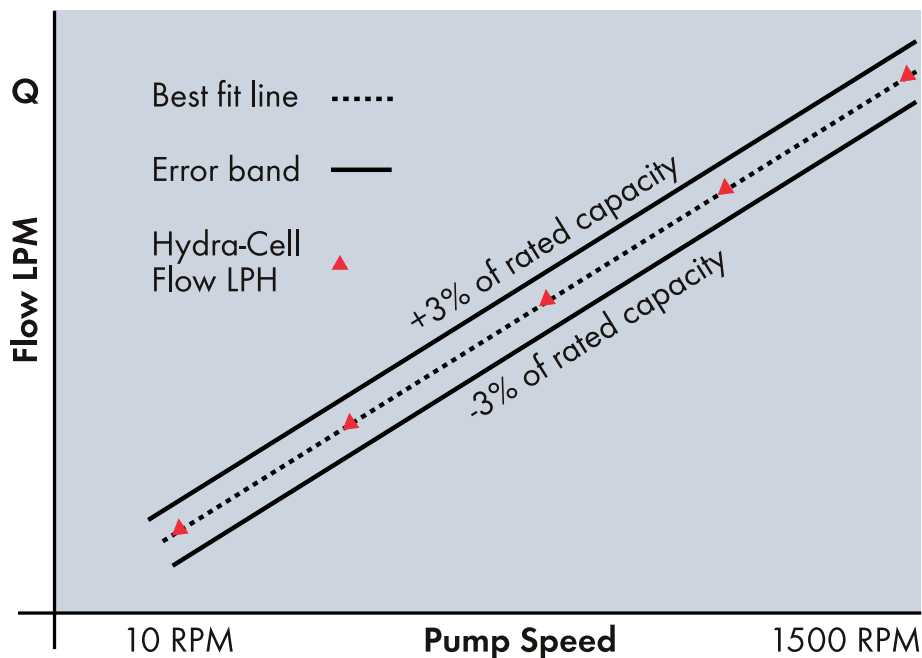
Flow (m³/hr)	Energy used (kw)		Energy saving	Potential annual euro saving
	Centrifugal	Hydra-Cell		
0.6	1.54	0.5	67%	€945
1.5	2.0	1.44	28%	€470

Compared with multi-stage centrifugal pumping water at 40 bar:

Flow (m³/hr)	Energy used (kw)		Energy saving	Potential annual euro saving
	Centrifugal	Hydra-Cell		
4.2	9.34	6.1	35%	€2,830
7.6	15.4	11.0	28%	€3,840

Minimal filtration to protect the pump

- No mechanical seals or tight tolerances that need protection by fine filtration. 300µm filtration is sufficient. (Some pumping technologies, such as axial piston pumps may need costly 5µm absolute filters for protection. These blind easily and may need replacing after 15 – 20 days use.)
- The level of filtration can be determined by what the membrane needs and not the needs of the high pressure pump, saving operating costs.



Simple robust design

- Designed and built for long service life
- Simple maintenance with no special tool requirements
- No critical tolerances to be aware of during maintenance
- In-situ repair possibilities... no costly removal and transportation to workshops or special clean environment

Membrane flushing

- Forward flushing and chemical treatment are made easier because the chemicals can readily pass through a Hydra-Cell® pump at a pressure of 2 bar, removing the need for extra pump bypass pipe work and control valves

Energy recovery compatible

- Suitable for use with pressure exchanger, energy recovery technology ▼



Hydra-Cell®

Performance

Advantages



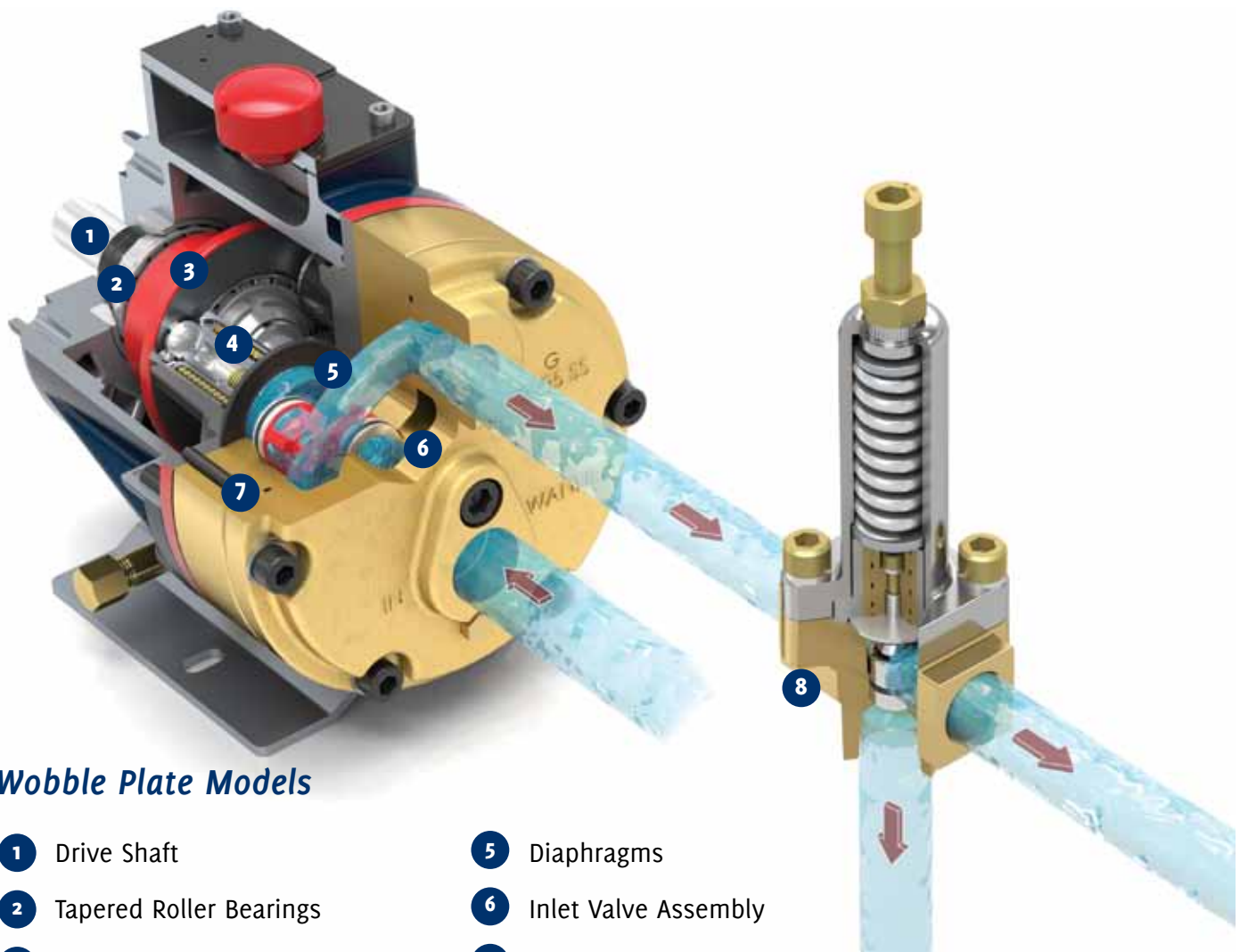
Waste stream reduction with Energy Recovery Device

Axial Piston Plunger Pump	Hydra-Cell® Advantages
Requires a pressure feed to maintain the hydrodynamic film between the piston foot and swash plate	The seal-less design of the Hydra-Cell® eliminates the requirement of pressure feed, saving costs
Requires careful operational monitoring so filters do not blind and cause damage	200 micron filtration is adequate to protect the pumps
Tight manufacturing tolerances can be degraded by the smallest of particles (5 micron absolute filters are often recommended (Cost \$500))	Hydra-Cell® can pump liquids with particles
Maintenance requires a clean environment to ensure the integrity of the tight tolerances	Hydra-Cell® offer simple design and maintenance of the liquid end and can often be done in-situ
Maximum inlet pressure of 5 bar	Hydra-Cell can handle up to 34 bar

Multistage Centrifugal Pumps	Hydra-Cell® Advantages
Large footprint required to achieve high pressure	Hydra-Cell® can meet these same flows and pressures with a much smaller footprint, saving space and costs
Mechanical seals and packing require adjustment, maintenance or replacement	The seal-less design of Hydra-Cell® means that there are no seals or packing to maintain or replace
Requires carefully balancing to reduce levels of vibration, seal failure and premature wear	Hydra-Cell® can be easily maintained in-situ
Efficiency quickly reduces when pump is operated away from its best efficiency point (Discharge pressure / fluctuations, Impellor or Seal wear)	Highly efficiency give significant energy savings

Reciprocating Plunger Pumps	Hydra-Cell® Advantages
Have dynamic seals that are design to leak to lubricate the pistons and plungers	The seal-less design of Hydra-Cell® mean that the pumped liquid and lubricating liquid are kept completely separate
Requires careful operational monitoring so filters do not blind and cause damage	Hydra-Cell® pumps do not require filtration
Valve closure by operator leading to liquid starvation, will cause immediate damage to the pump	Hydra-Cell®'s Kel-Cell technology protects the pump, allowing the operator to rectify the error without causing damage.

Hydra-Cell® Principles of Operation - Wobble Plate



Wobble Plate Models

- | | |
|--------------------------------|---------------------------------|
| 1 Drive Shaft | 5 Diaphragms |
| 2 Tapered Roller Bearings | 6 Inlet Valve Assembly |
| 3 Fixed-angle Cam/Wobble Plate | 7 Discharge Valve Assembly |
| 4 Hydraulic Cells (Patented) | 8 C62 Pressure Regulating Valve |

Reliable, Efficient Pumping Action

The drive shaft (1) is rigidly held in the pump housing by a large tapered roller bearing (2) at the rear of the shaft and a smaller bearing at the front of the shaft. Set between another pair of large bearings is a fixed-angle cam or Wobble Plate (3).

As the drive shaft turns, the swash plate moves, oscillating forward and back (converting axial motion into linear motion). The complete pumping mechanism is submerged in a lubricating oil bath.

The hydraulic cell (4) is moved sequentially by the Wobble plate and filled with oil on their rearward stroke. A ball check valve in the bottom of the piston ensures that the cell remains full of oil on its forward stroke.

The oil held in the Hydra-Cell balances the back side of the diaphragms (5) and causes the diaphragms to flex forward and back as the Wobble plate moves. This provides the pumping action.

To provide long trouble-free diaphragm life, Hydra-Cell hydraulically balances the diaphragm over the complete

pressure range of the pump. The diaphragm faces only a 0.21 bar pressure differential regardless of the pressure at which liquid is being delivered - up to 172 bar on standard Hydra-Cell models and Hydra-Cell metering pumps.

Hydra-Cell Wobble plate pumps can have up to five diaphragms, and each diaphragm has its own pumping chamber that contains an inlet and discharge self-aligning horizontal disk check valve assembly (6). As the diaphragms move back, liquid enters the pump through a common inlet and passes through one of the inlet check valves. On the forward stroke, the diaphragm forces the liquid out the discharge check valve (7) and through the manifold common outlet. Equally spaced from one another, the diaphragms operate sequentially to provide consistent, low-pulse flow.

A Hydra-Cell C62 pressure regulating valve (8) is typically installed on the discharge side of the pump to regulate the pressure of downstream process or equipment.

Pump selection



Food additive manufacture –
Ultra filtration of intermediary products.

Liquid Head Materials

For brackish or seawater applications the choice of liquid head material will depend on the level of dissolved solids (TDS).

TDS Level	Liquid End Material
<15,000 ppm	Brass
<25,000 ppm	316 Stainless Steel
>25,000 ppm	Duplex Stainless Steel

For RO systems that are used to treat chemical waste streams, a wide range of materials is available, including:

- Hastelloy® CW12MW
- Duplex Alloy 2205
- Super Duplex Alloy 2507
- 316L Stainless Steel
- Brass
- Cast Iron
- Polypropylene
- PVDF (Kynar®)

Diaphragm Materials

A variety of materials is available to suit varying performance conditions, including:

- EPDM
- FKM
- PTFE
- Neoprene
- Buna
- Aflas®

Treated Internal Surfaces

- Internal surfaces in contact with the liquid can be polished to the following specifications:
 - 0.8 Ra
 - 0.4 Ra
- Stainless Steel internal surfaces in contact with the liquid can be supplied passivated.

Pipe Connections

Simple threaded connections.



Flanged connections.

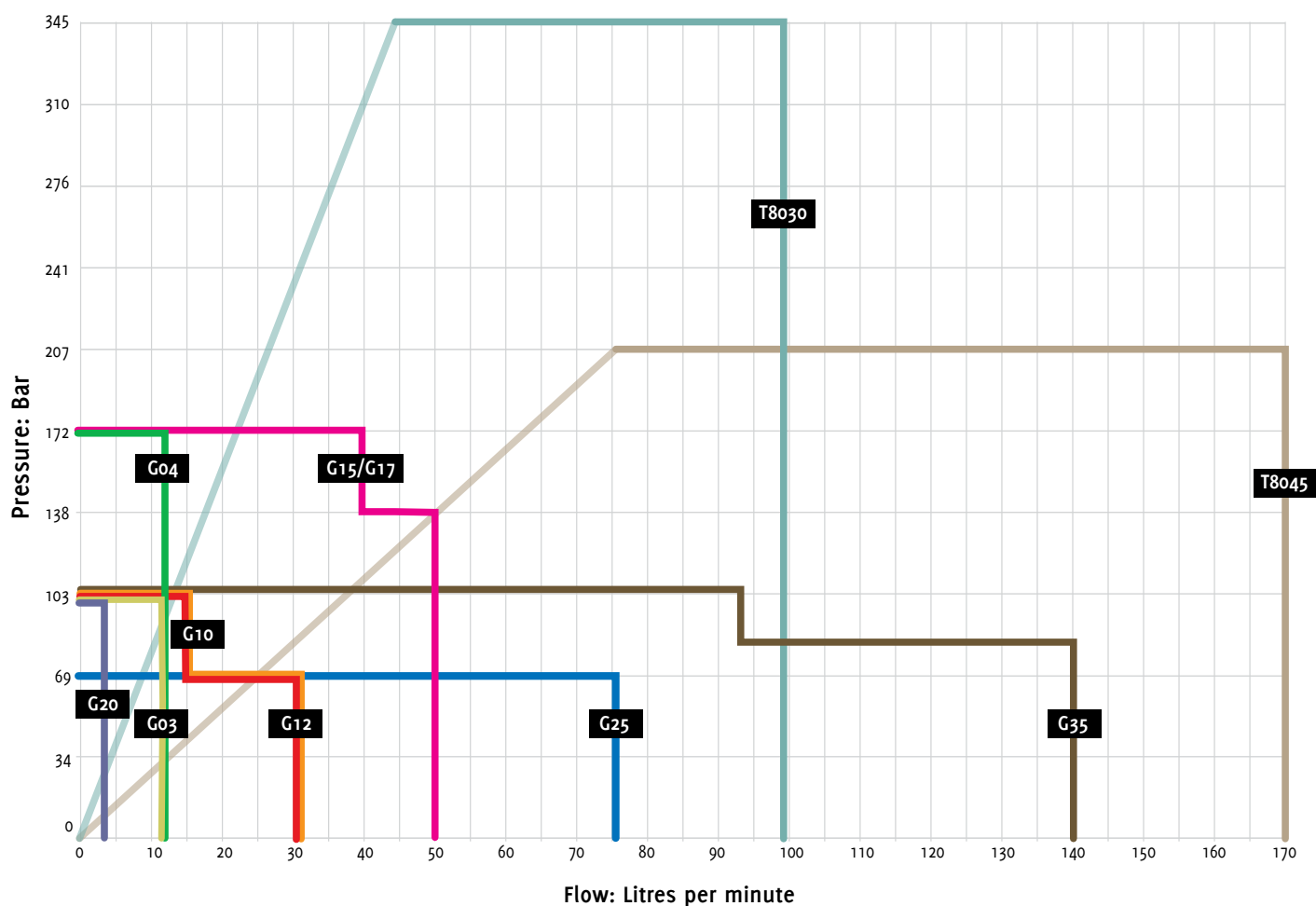


Specialised flange connections
e.g. Tri-Clamp® for pharmaceutical
and food applications.



Hydra-Cell® Flow Capacities and Pressure Ratings

G Series and T Series Seal-less Pumps



The graph above displays the maximum flow capacity at a given pressure for each model series. The table below lists the maximum flow capacity and maximum pressure capability of each model series.

Please Note: Some models do not achieve maximum flow at maximum pressure. Refer to the individual model specifications in this section for precise flow and pressure capabilities by specific pump configuration.

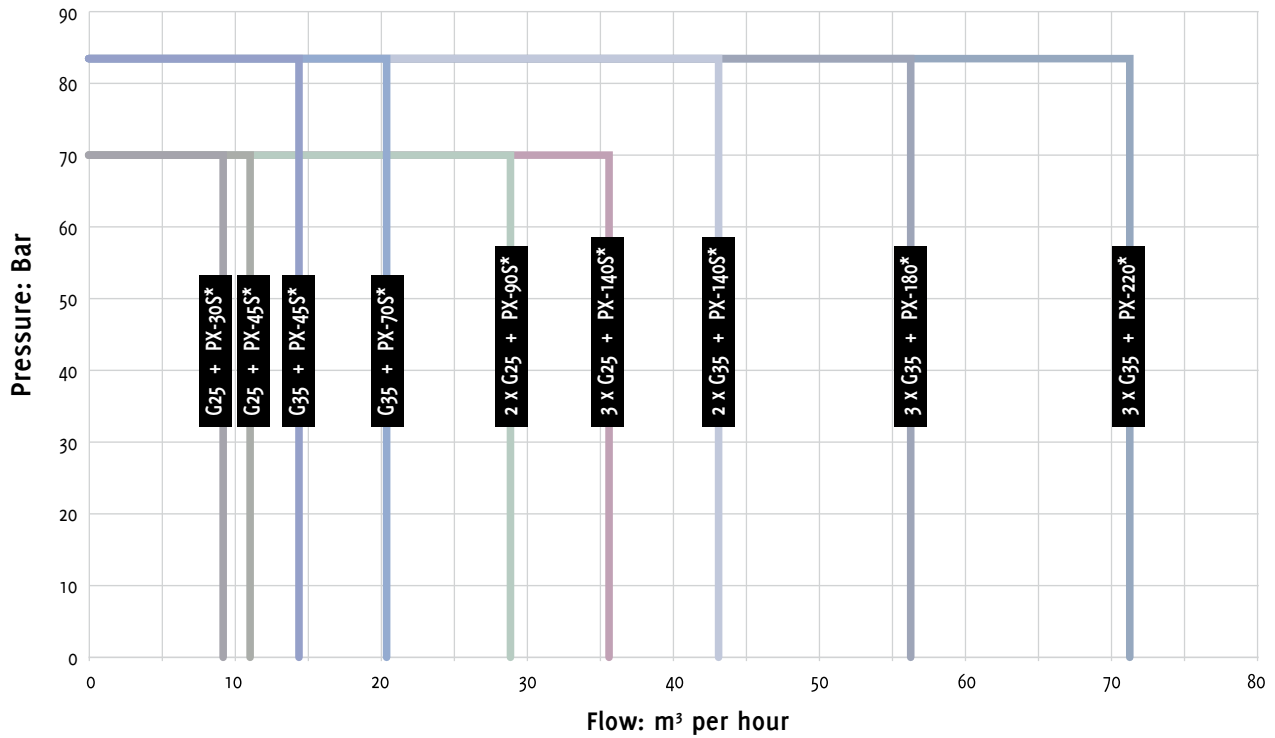
Model	Maximum Capacity l/min	Maximum Discharge Pressure bar		Maximum Operating Temperature °C ²		Maximum Inlet Pressure bar
		Non-Metallic ¹	Metallic	Non-Metallic	Metallic	
G20	3.8	24	103	60°	121°	17
G03	11.7	24	103	60°	121°	17
G04	11.2	N/A	172	N/A	121°	34
G10	33.4	24	103	60°	121°	17
G12	33.4	N/A	103	N/A	121°	17
G15/17	58.7	N/A	172	N/A	121°	34
G25	75.9	24	69	60°	121°	17
G35	138	N/A	103	N/A	121°	34
T8045	170.4	N/A	207	N/A	82°	34
T8030	98.4	N/A	345	N/A	82°	34

¹ 24 bar maximum with PVDF (Kynar®) liquid end; 17 bar maximum with Polypropylene liquid end.

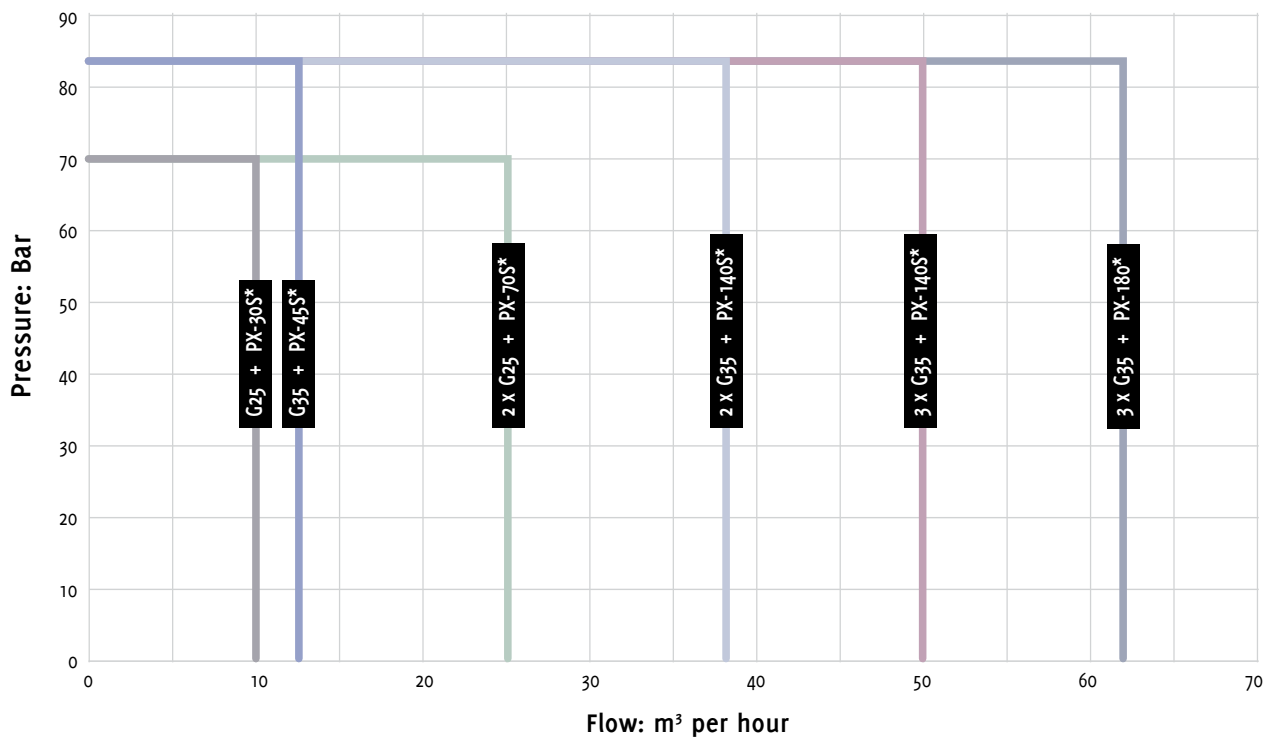
² Consult factory for correct component selection for temperatures from 160°F (71°C) to 250°F (121°C).

Hydra-Cell® + ERI PX® Energy Recovery Device

At 35% Recovery



At 40% Recovery



*PX Pressure Exchanger, PX and Pressure Exchanger are registered trademarks of Energy Recovery Inc.

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