Hydra-Cell®

Seal-less Pumps

Accurate, Reliable, Efficient Pumps that Handle Particulates for Water & Wastewater Treatment and Reverse Osmosis

Water/Wastewater & Reverse Osmosis

Wanner Engineering, Inc.

Pressure Injecting and Mixing • Cleaning • Spraying • Metering and Dosing • High-Pressure Transfer

Compact, Seal-less Pumps Reduce Costs and Provide Dependable Performance

The unique seal-less, multiple-diaphragm design of Hydra-Cell offers distinct benefits throughout many applications in the water and wastewater treatment industries as well as for reverse osmosis (RO) nano-filtration and ultra-filtration. For example, Hydra-Cell is ideal for pumping a wide range of corrosive chemicals and polymers and for handling brackish and "gray" water that may contain particulate matter.

With more than 40 years of experience serving the industry, including many of the major global companies, Hydra-Cell pumps are performance-proved in efficiently pumping the widest range of fluids, including corrosive, hot, abrasive, viscous, non-lubricating, and recycled fluids as well as liquids containing solids. The multiple-diaphragm, seal-less design of Hydra-Cell provides 100% safe containment for even the most aggressive liquids while providing virtually pulse-free operation.

Advantages of Hydra-Cell:

- Variety of models, wide range of capacities and ratings, plus extensive choices in materials of construction make Hydra-Cell ideally suited to many different water and wastewater treatment applications as well as RO, nano-filtration, and ultra-filtration.
- Accurate and easy-to-control because the flow rate is proportional to the pump speed.
- Pumps the full spectrum of low-to-high viscosity fluids.
- Seal-less design can tolerate abrasive solids and particulate matter of up to 800 microns diameter depending on model.
- Operational efficiencies reduce energy costs.
- Able to run dry without damage (or additional maintenance) to the pump in case of accident or operator error.
- Tolerates non-ideal operating conditions.
- Minimizes maintenance and downtime because there are no mechanical seals, packing, or cups to leak or replace.
- Metering pump models designed to exceed API 675 performance standards and provide virtually pulse-free, linear flow without the use of expensive pulsation dampeners.

Hydra-Cell Pumps Selection and Applications

Hydra-Cell positive displacement pumps are available in 15 pump models covering a wide range of flows and pressures.

Nine (9) seal-less Hydra-Cell models are ideal for transfer, spraying, and pressure injecting and mixing.

Six (6) metering pump models are ideal for metering and dosing, spraying, and pressure injecting, and mixing.

Hydra-Cell pumps are used in many industries including agricultural, chemical processing, oil and gas processing, municipal water and wastewater, pharmaceutical, power generation, pulp and paper, and shipping. They have many specific applications such as:

- Chemical & Pharmaceutical Plant Waste Stream Reduction & Salt Solution Concentration
- Food & Beverage Concentration

- Military Shipboard RO Units
- Mobile Water Purification Systems
- Offshore & Shipboard Desalination

- Pharmaceutical & Laboratory Process Water Purification & Conditioning
- Remote & Skid-mounted Drinking Water Production
- Seawater and High-brackish Water Desalination

- Solute Concentration
- Solvent/Acid Recovery
- Wastewater Reduction

Reverse Osmosis • Nano-filtration • Ultra-filtration

Typical Liquids Pumped	Challenges in Pumping	The Hydra-Cell Advantage
Seawater (30 - 65k TDS)	Salt is highly corrosive and can damage pump.	• No dynamic seals to wear so corrosive liquids can be pumped reliably. • Corrosion-resistant liquid end materials available.
	Crystallization can occur on internal surfaces when pump is not in operation, causing clogging, reduced efficiency, and premature wear of dynamic seals or areas of tight tolerances.	• Spring-loaded, horizontal disk check valves reduce clogging and maintain efficiency. • Seal-less design has no tight tolerances that can be damaged by salt crystals. • No dynamic seals to leak, wear, or replace.
	Non-lubricating.	• No dynamic seals that need to be lubricated by the process liquid.
	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.	• Seal-less design and horizontal disk check valves can handle abrasives up to 800 microns in size (depending on pump model) without the need for pre-filtration. • No dynamic seals or tight tolerances.
	Poorly maintained pre-filtration system can cause a high-pressure pump to run dry and damage pump.	• Can run dry without damage to the pump.
Brackish Water (18 - 25k TDS)	Solid particles may be present from poorly attended pre-filtration.	• Seal-less design and horizontal disk check valves can handle abrasives up to 800 microns in size (depending on pump model) without the need for pre-filtration.
	Remote units may run dry and damage pump.	• Can run dry without damage to the pump.
Waste Solvent Streams (Mixture of Water & Various Solvents)	May be corrosive and non-lubricating.	• No dynamic seals so aggressive or corrosive liquids can be pumped reliably. • Corrosion-resistant liquid end materials available. • No dynamic seals that need to be lubricated by the process liquid.
Wastewater Streams (Food & Beverage Processing)	Un-dissolved solids can be abrasive.	• Seal-less design and spring-loaded, horizontal disk check valves can handle abrasive, un-dissolved particles up to 800 microns in size (depending on model).
	May be aggressive/corrosive and non-lubricating.	• No dynamic seals so aggressive or corrosive liquids can be pumped reliably. • Corrosion-resistant liquid end materials available. • No dynamic seals that need to be lubricated by the process liquid.
Chemicals (Acids; Salt Solutions; Proprietary Chemicals)	Potentially corrosive - can damage pump.	• No dynamic seals to wear so corrosive liquids can be pumped reliably. • Corrosion-resistant liquid end materials available.
	Leaks can be harmful.	• No cups, packing, or mechanical seals to leak. • Seal-less pump chamber provides 100% containment.

Water and Wastewater Treatment

Typical Liquids Pumped	Challenges in Pumping	The Hydra-Cell Advantage
Lime Slurries (Balance pH; Soften Water)	Abrasive - can damage pump.	• Seal-less design handles abrasive particles up to 800 microns in size (depending on pump model).
	Requires smooth, controllable flow.	• Multiple-diaphragm design provides smooth, virtually pulse-less flow. • Flow rate is proportional to pump speed (rpm) and easy to control.
Sodium Hydroxide (Control pH)	Crystallization can occur when excessive air leaks through seals, causing clogging and reduced efficiency.	• Spring-loaded, horizontal disk check valves reduce clogging and maintain efficiency.
	Corrosive - can damage pump.	• Seal-less design provides no leak path and handles corrosive fluids. • Corrosion-resistant liquid end materials available.
Sulfuric Acid (Correct pH in Potable Water; Air Scrubbing)	Crystallization can occur when excessive air leaks through seals, causing clogging and reduced efficiency.	• Spring-loaded, horizontal disk check valves reduce clogging and maintain efficiency.
	Corrosive - can damage pump.	• Seal-less design provides no leak path and handles corrosive fluids. • Corrosion-resistant liquid end materials available.
Hydrochloric Acid - up to 37% concentration (Correct pH)	Crystallization can occur when excessive air leaks through seals, causing clogging and reduced efficiency.	• Spring-loaded, horizontal disk check valves reduce clogging and maintain efficiency.
	Corrosive - can damage pump.	• Seal-less design provides no leak path and handles corrosive fluids. • Corrosion-resistant liquid end materials available.
Sodium Hypochlorite (Disinfection; Odor Control)	Crystallization can occur when excessive air leaks through seals, causing clogging and reduced efficiency.	• Spring-loaded, horizontal disk check valves reduce clogging and maintain efficiency.
	Outgassing adversely affects pump valves.	• High pump speed, high compression ratio, and large discharge ports prevent outgassing.
Polymers and Polyelectrolytes (Flocculation; Coagulation; Clarification)	Shear-sensitive gel structures can be broken down easily.	• Provides low-shear pumping action and virtually pulse-less flow that protect polymers.
	Difficulty in pumping high-viscosity fluids.	• Low-shear pumping action also handles higher-viscosity fluids.
	Requires smooth, controllable flow.	• Multiple-diaphragm design provides smooth, virtually pulse-less flow. • Flow rate is proportional to pump speed (rpm) and easy to control.
Alum (Coagulate Fine Suspended Particles in Potable Water)	Abrasive - can damage pump.	• Seal-less design handles abrasive particles up to 800 microns in size (depending on pump model).
	Corrosive - can damage pump.	• Seal-less design provides no leak path and handles corrosive fluids. • Corrosion-resistant liquid end materials available.

Water and Wastewater Treatment

Typical Liquids Pumped	Challenges in Pumping	The Hydra-Cell Advantage
Phosphate Solutions (Oxygen Scavenger for High-Pressure Steam Lines; Prevent Build-up of Scale; Reduce Corrosion)	High discharge pressure puts strain on system.	• Hydraulically-balanced diaphragms maintain consistent pressure throughout the system.
	Crystallization can occur when excessive air leaks through seals, causing clogging and reduced efficiency.	• Spring-loaded, horizontal disk check valves reduce clogging and maintain efficiency.
	Corrosive - can damage pump.	• Seal-less design provides no leak path and handles corrosive fluids. • Corrosion-resistant liquid end materials available.
Potassium Permanganate (Remove Objectionable Tastes and Odors)	Potentially harmful and toxic.	• Seal-less pump chamber provides 100% containment.
	Accurate dosing essential.	• Flow rate is directly proportionate to pump speed (rpm), maintaining dosing accuracy better than +/- 0.5%.
Gray Water - containing particles (High-Pressure Cleaning: Algae Growth; Weir Cleaning in Settling Tanks; Screen and Filter Cleaning/Backwashing)	Solid particles in water (e.g. sand and other contaminants) are abrasive and can damage pump.	• Seal-less design and spring-loaded, horizontal disk check valves handle particles up to 800 microns in size (depending on pump model) without damage to the pump.
Hydrogen Peroxide (Disinfection)	Corrosive - can damage pump.	• Seal-less design provides no leak path and handles corrosive fluids. • Corrosion-resistant liquid end materials available.
	Outgassing adversely affects pump valves.	• High pump speed, high compression ratio, and large discharge ports prevent outgassing.
	Breaks down when exposed to light.	• Seal-less pump chamber provides 100% containment.
Iron Sulfate (Precipitation of Phosphates and Heavy Metals)	Sensitive to air and oxides - becomes corrosive when in contact with moisture.	• Seal-less design provides no leak path and handles corrosive fluids. • Corrosion-resistant liquid end materials available.
Manganese Oxide (Removes EE2 when Suspended in Water)	Abrasive liquid contains non-soluble solids.	• Seal-less design and spring-loaded, horizontal disk check valves handle particles up to 800 microns in size (depending on pump model) without damage to the pump.
Liquid Ferric Chloride (Coagulant; Clarifier; Sludge Dewatering; Turbidity Removal)	Complete non-metallic pump head required.	• Hydra-Cell pump models are available with complete non-metallic pump heads.

"Using Hydra-Cell pumps for feeding highly corrosive chemicals into spray bars for cleaning screens, we discovered other applications where the pumps could offer additional benefits for our end users, including polymer feed equipment products. The reliable performance of Hydra-Cell provides an insurance policy for applications where a pump may run dry. It also delivers a near continuous feed of polymer, and the pumps are easy and inexpensive to maintain. Most pumps can't perform under such high pressures with such corrosive elements. However, Hydra-Cell pumps can perform at a linear rate over a wide pressure range and run dry without damage. This made it an easy choice to use Hydra-Cell in our systems."

Dave Descutner
Owner
Atlantis Technologies, LLC

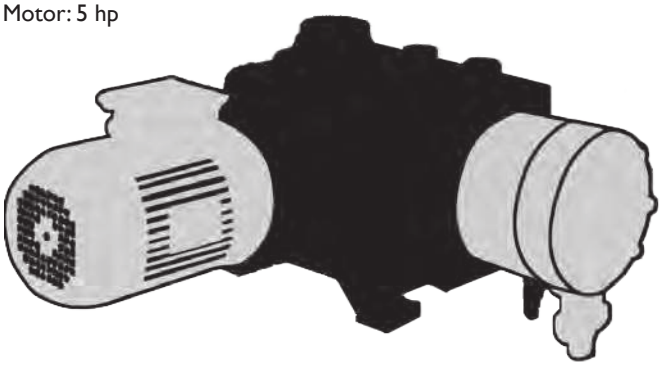
Lower Initial Investment

Uses lower hp motors

- Although both pumps have the same pressure rating, the lighter, more compact Hydra-Cell has a higher flow rating while requiring a less expensive, lower hp motor. This means Hydra-Cell saves approximately 30% to 55% on initial costs.

Hydra-Cell metering pump
Weight: 83.5 lbs. (with motor)
Rated: 2500 psi at 36 gph
Motor: 1-1/2 hp

Conventional metering pump
Weight: 220 lbs. (with motor)
Rated: 2500 psi at 29 gph
Motor: 5 hp



Minimal filtration

- Unlike gear pumps and screw pumps that wear excessively without fine filtration, Hydra-Cell has no dynamic seals or tight tolerances that need protection by fine filtration.
- Seal-less design handles abrasive particles up to 800 microns in size (depending on pump model) and up to 9 hardness on the Mohs scale.
- Can pump liquids with non-dissolved solids up to 40% depending on particle distribution.
- Unaffected by lapses in filtration, reducing costly pump repairs.
- Less need for costly filtration management and maintenance.

Simple membrane flushing

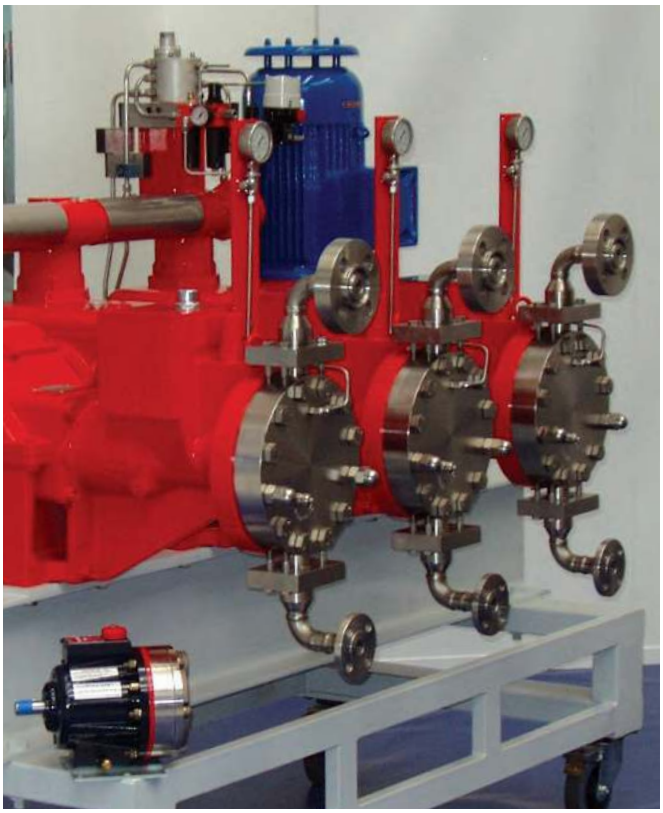
- Forward flushing and chemical treatment are easier because chemicals can readily pass through a Hydra-Cell pump at lower pressure (30 psi/2 bar) eliminating the need for extra pump bypass pipe work and control valves.

Small footprint for savings

- Compact design can mean up to 30% lower initial cost compared to other pumps.
- Space-saving design creates a smaller footprint for more efficient use of plant space.
- Easier to access for routine maintenance or servicing.

Ratings

Flow:	396 gph (1500 lph)
Pressure:	1160 psi (80 bar)



Pumps Shown to Scale

The Hydra-Cell and triplex metering pumps both have the same flow capacity and pressure rating; however, space-saving Hydra-Cell has a much smaller footprint. Conventional metering pumps can become oversized and overpriced at higher flow/pressure requirements.

High Efficiency and Lower Energy Costs

Low power consumption - 85% to 90% energy efficiency

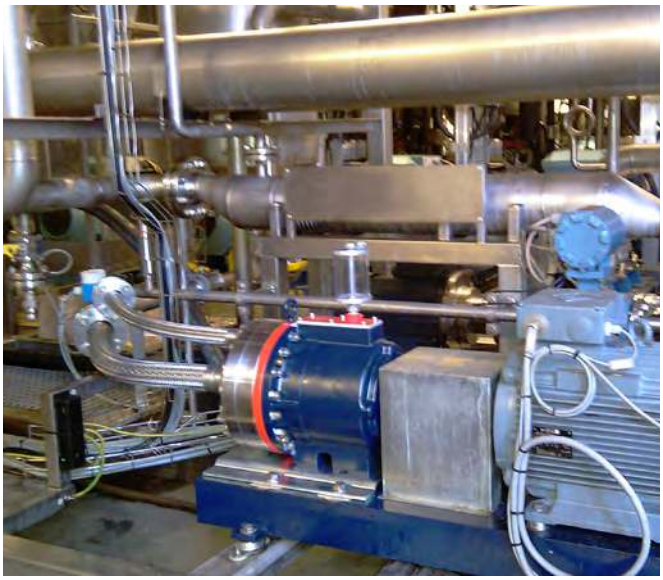
- Hydra-Cell typically requires a more compact, lower cost, lower hp motor than pumps with similar flow and pressure ratings.
- Compared to other types of pumps, Hydra-Cell achieves the same performance but with greater energy efficiency and less power consumption.
- Two Hydra-Cell models are compatible with pressure exchanger energy recovery technology to provide greater energy efficiency.

Energy Efficiency with ERD Technology

Hydra-Cell Model	Energy Recovery Device (ERD)	Flow Rate (gph)	Discharge Pressure (psi)	Pump Power Use (kW)
H25	PX - 30S ERI	46	1000	11.8
D35	PX - 70S ERI	80	1200	22.3

ERI: Energy Recovery, Inc.

The multiple-diaphragm liquid head of Hydra-Cell also allows a less expensive, energy-saving motor to be used.



Nano-filtration in the handling of a caustic fluid to produce Xylitol.

Metering flocculants for wastewater treatment.

Energy Cost Comparisons

Pump Type	Flow (gpm)	Pressure (psi)	Absorbed Power (kW)	Energy Usage	Annual Savings with Hydra-Cell
Screw Pump A	1.06	1160	2.8	147% more energy	$756
Hydra-Cell M03	1.06	1160	0.7	than Hydra-Cell	
Screw Pump B	7.66	1000	8.3	97% more energy	$1,476
Hydra-Cell D10	7.66	1000	4.2	than Hydra-Cell	
Screw Pump C	31.17	1160	34.5	78% more energy	$5,400
Hydra-Cell D35	31.17	1160	19.5	than Hydra-Cell	
Centrifugal Pump A	7.66	580	5.6	112% more energy	$1,116
Hydra-Cell D10	7.66	580	2.5	than Hydra-Cell	
Centrifugal Pump B	35.13	580	15.4	35% more energy	$1,440
Hydra-Cell D35	35.13	580	11.4	than Hydra-Cell	

Efficiencies compiled from manufacturers' published data sheets.

Energy cost savings are calculated based on pumps running 4,000 hours per year at 9 cents per kilowatt hour.

Pumps Abrasives and Low-to-High Viscosity Fluids

Many applications in water/wastewater treatment and RO involve pumping abrasives and solid particles. Hydra-Cell's horizontal check valve orientation will handle abrasives and particulates without clogging or damage to the pump.

Handles abrasives and particulates

- Seal-less design and spring-loaded, horizontal disk check valves provide superior handling of abrasive fillers and particulates.
- Reliably pumps acids and caustics which crystallize.
- Efficiently pumps liquids with solids such as lime slurries and sour water containing sand.

Runs dry without damage

- Running dry can damage or destroy gear pumps and screw pumps, requiring costly repairs or pump replacement, and resulting in lost production. Hydra-Cell pumps can run dry without damage to the pump.
- When an interruption in flow is caused by suction blockage or a valve closure, gear pumps and screw pumps can fail immediately. Hydra-Cell pumps equipped with Kel-Cell® Diaphragm Position Control (DPC) will not be affected, allowing for correction of the interruption.

Environmental protection

- Liquids are 100% sealed from the atmosphere.
- No leak path for toxic vapors or harmful gases (e.g. H_2S).
- No dynamic seals to leak any Volatile Organic Compounds (VOC).

Handles low-to-high viscosity fluids

- Pumps thin to highly viscous liquids throughout the entire pressure range.
- Low-shear pumping action makes Hydra-Cell ideal for pumping and protecting shear-sensitive polymers.
- Non-lubricating liquids can be pumped reliably.

Long-distance transfer to a water and wastewater treatment plant.

Accurate Metering and Dosing with Pulse-free, Linear Flow

Accurate electronic flow control

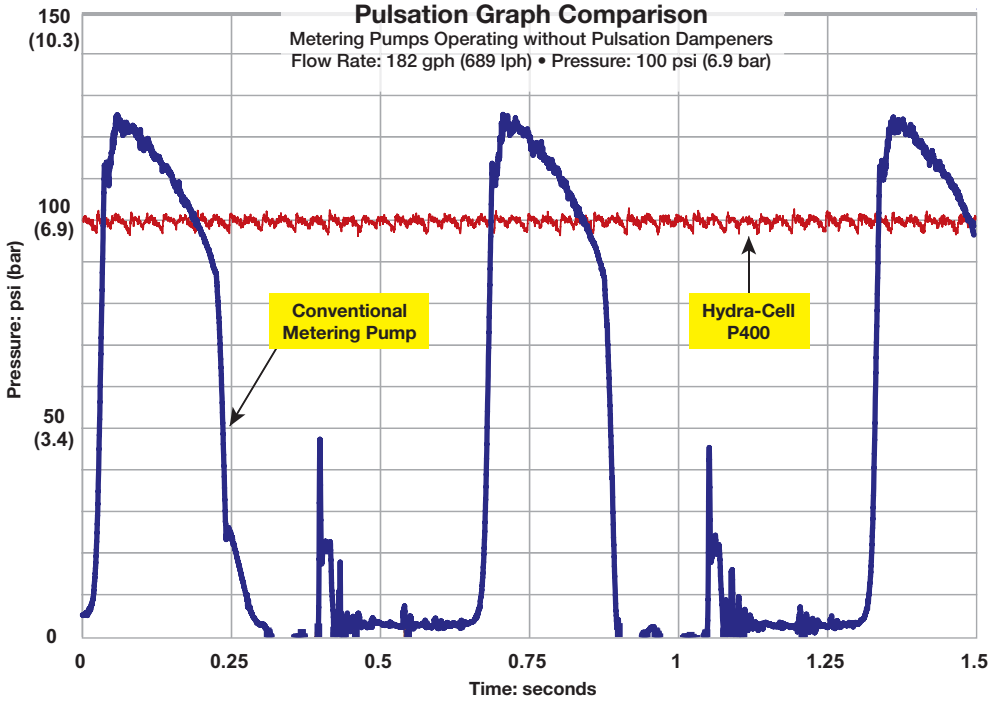
- Compared to pumps that rely on manual stroke adjustment or expensive actuators to change flow, Hydra-Cell metering pumps utilize speed control for greater accuracy throughout the turndown range.
- Can be equipped with solid-state electronic flow control where the volume per every stroke is constant and a known value.
- Electronic flow also provides easy calibration of the desired feed rate and a near instantaneous rate of change (0 to maximum rpm in 0.3 seconds).

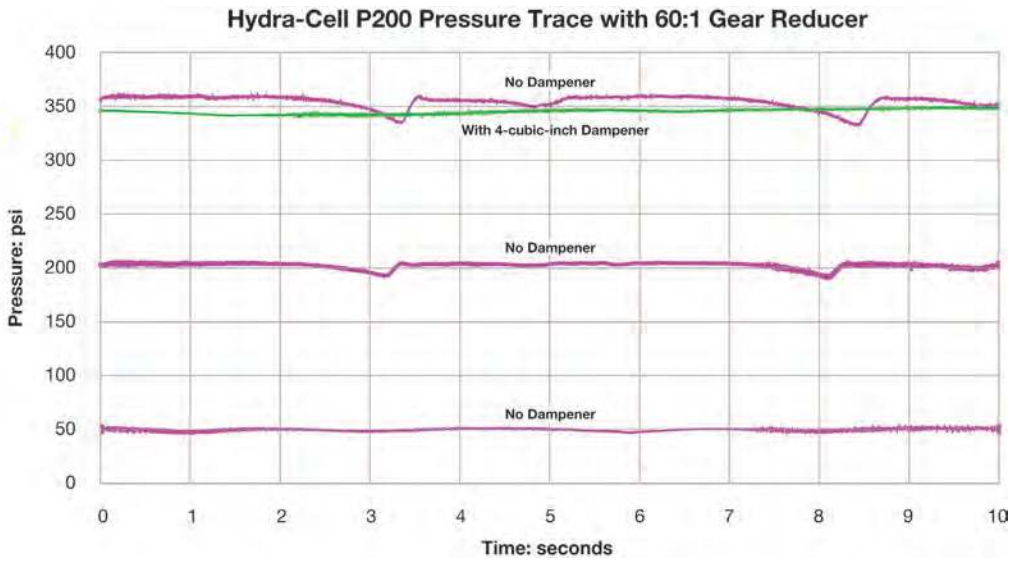
	Standard Hydra-Cell Models	Hydra-Cell P Series Metering Pumps
Steady State Accuracy	±1%	±1% or better
Repeatability	±3%	±3% or better
Linearity	±3%	±3% or better

Typical results for recommended speed range

Virtually pulse-free flow

- Multiple-diaphragm design minimizes pulsations, eliminating the need for expensive pulsation dampeners for most Hydra-Cell models.
- Reduces pipe strain.
- Enhances operating safety.
- Minimizes maintenance.
- Reduces acceleration/friction losses in the suction line.
- Provides accurate metering with linear, constant flow.
- Lowers system acquisition costs.





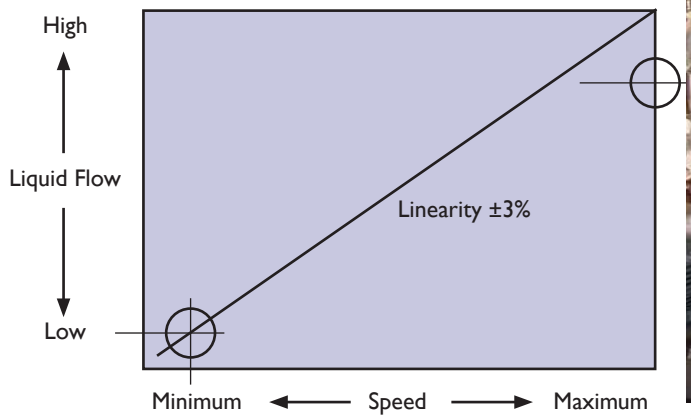
Consistent Flow Independent of Pressure

Controlled, accurate delivery

- Through simple, open-loop torque control of the motor, Hydra-Cell provides predictable, controllable pressure and flow rate.
- Since flow rate is dependent upon the pump speed and not the discharge pressure, Hydra-Cell delivers precise, accurate flow best suited for the application.
- Hydra-Cell can deliver the required flow rate whether pumping low- or high-viscosity fluids.
- Pump speed can be adjusted from low-to-high speeds (18 to 1800 rpm depending on model) while maintaining discharge pressures and accurate flow control.
- Seal-less design means there are no dynamic seals to "leak" pressure.
- Can be equipped with solid-state electronic flow control where the volume per every stroke is constant and a known value.
- Controllable flow rate allows for efficiencies and yields to be maintained if feed water TDS increases. This is critical in bore hole applications because an increase in salt concentration results in an increase in osmotic pressure.

D35 pump designed to military-grade specifications for RO application.

Linearity - Speed/Flow Relationship



Hydra-Cell pumps provide consistent linear flow within ±3% at a fixed pressure, regardless of the flow rate or pump speed.

Membrane waste solvent treatment.

Filtration of algae products for a manufacturer of cosmetics.

RO recovery device.

One Versatile, Low-Maintenance Pump Design

Adaptable to many applications

- One Hydra-Cell seal-less design with 15 models (9 seal-less; 6 metering) covers a wide range of operating flows and pressures.
- Can be fitted with ANSI, SAE or DIN flanges, IEC or NEMA motor mounts, or provided with ATEX certification to adapt to specific applications or meet international standards.
- Proven record of replacing different pump technologies with improved abrasives handling, less maintenance, and other benefits (as detailed on pages 12-15).

Extensive operating range

- Shaft speeds from 6 rpm to 1800/1200 rpm, yielding a 300/200:1 turndown ratio.
- Maximum discharge pressures from 1000 to 2500 psi.
- Maximum flow rates for seal-less Hydra-Cell models from 1 to 68 gpm and for metering pumps from 27 to 890 gph.
- Minimum flow rates less than 0.15 gph at approximately 6 rpm.

Simple pump head design

- Liquid head materials can be changed readily, enabling Hydra-Cell to be used for many different chemicals and liquids pumped.
- Minimal maintenance required with no special tools needed.
- Low cost of spare parts.

Low maintenance

- No mechanical seals, cups or packing to leak, wear, or replace.
- No tight tolerances that could be susceptible to corrosion or damaged by solid particles.
- One design for all applications minimizes the need for standby pumps and spare parts, which optimizes training and service expertise and reduces inventory size and expense.
- Since there are no dynamic seals to wear or replace, Hydra-Cell pumps need little maintenance and will operate reliably under continuous duty at high pressure.
- Any maintenance or repair can usually be performed on-site.
- Can operate up to 6,000 hours between lubricating oil changes (compared to 1,500 hours recommended by many piston pump manufacturers).

Hydra-Cell operating in a wastewater treatment facility.

RO treatment of waste streams at a pharmaceutical processing facility.

RO treatment of high TDS groundwater at a cement production plant.

Hydra-Cell® Performance Advantages Compared to Other Types of Pumps

Conventional Metering Pump Disadvantages:	Hydra-Cell Advantages:
• Use manual stroke adjusters or expensive actuators to control flow, which can result in pumping inaccuracies, lost motion, operator error, and a greater chance of leakage.	• Hydra-Cell employs optional Variable Frequency Drive (VFD) electronic flow control for greater accuracy and repeatability, eliminating lost motion, reducing the chance of operator error, and removing a potential leak path.
• Require expensive pulsation dampeners to minimize pulsations.	• Multiple-diaphragm design provides virtually pulse-free flow, so expensive pulsation dampeners may not be required.
• May only offer PTFE diaphragms, requiring frequent replacement due to stress and poor elastomeric memory.	• Available with a wide choice of cost-effective, elastomeric diaphragm materials.
• Large footprint to achieve required maximum flow and pressure.	• Can meet the same flow and pressure requirements with a much smaller footprint, saving space and costs.
• Different plunger and liquid end sizes needed to accommodate changes in operating pressures.	• Operates over a wide range of pressures without changes to the plunger or liquid end size.
• Integral gearing (necessary to prevent cross-contamination of actuating oil) is difficult and expensive to maintain.	• The simplicity of design means lower parts and maintenance costs. • Separate gearbox prevents cross-contamination of the actuating oil.

Centrifugal Pump (Multi-stage) Disadvantages:	Hydra-Cell Advantages:
• Mechanical seals and packing require maintenance and replacement or adjustment.	• The seal-less design of Hydra-Cell means that there are no mechanical seals or packing to leak or replace.
• Particulates and fines in the pumped fluid will cause wear in the case and the impellers.	• Seal-less pumping chamber with spring-loaded, horizontal disk check valves can pump particulates and fines up to 800 microns in size (depending on pump model).
• Difficult to maintain high efficiency while varying outlet pressure.	• Designed for efficient, high-pressure delivery.
• Running dry and air entrapment can cause catastrophic failure.	• Can run dry without damage to the pump. Entrapped air does not cause immediate failure.
• Ineffective at low speeds and high outlet pressures.	• Runs at very low speeds (from 18 to 1800 rpm) while maintaining outlet pressures.
• Flow rate is difficult to control effectively.	• Positive displacement design allows for accurate speed control.
• Higher pressure requires additional stages with an increasing footprint for horizontal pumps.	• Can meet the same flow and pressure requirements with a much smaller footprint, saving space as well as investment and operation costs.

Compared to other pumps, Hydra-Cell requires minimal maintenance for water and wastewater treatment or RO. Hydra-Cell has no packing or dynamic seals that leak or need to be replaced and no internal gears to wear.

Triple Screw Pump Disadvantages:	**Hydra-Cell Advantages:**
• Close tolerances and running clearances require ultra-filtration (usually to <10 microns).	• Precisely-engineered tolerances and seal-less design eliminate the need for fine filtration.
• Performance characteristics sensitive to viscosity change.	• Pumps thin or highly viscous liquids with equal efficiency.
• Mechanical seals and packing require maintenance, and replacement or adjustment.	• The seal-less design of Hydra-Cell means that there are no mechanical seals or packing to leak or replace.
• Does not tolerate solids, fines, abrasives or particulates.	• Seal-less pumping chamber with spring-loaded, horizontal disk check valves can pump fines up to 800 microns in size (depending on pump model).
• Inefficient at low speeds (usually requires minimum 1000 rpm).	• Runs at very low speeds (from 18 to 1800 rpm) while maintaining outlet pressures.
• Depends on pumped fluid for sealing and hydrodynamic lubrication.	• No requirement for the pumped fluid to seal or lubricate.
• Contains bushings in the pumped fluid.	• No bushings in the pumped fluid.
• Dry running and entrapped air cause immediate damage.	• Can run dry without damage to the pump. Tolerates entrapped air.
• Incorrect direction of rotation results in damage to the pump.	• Hydra-Cell pumps are bidirectional, eliminating the risk of damage.

Plunger/Piston Pump Disadvantages:	**Hydra-Cell Advantages:**
• Packing requires frequent adjustments and then replacement as it wears.	• Seal-less design uses no packing, reducing downtime and maintenance costs.
• Packing must leak to provide lubrication - creating maintenance, environmental, safety, and housekeeping issues with their associated costs.	• No packing means no secondary containment requirements, no clean-up or disposal issues, improved safety, and reduced maintenance costs.
• Packing causes plunger wear, which is made worse by abrasive media; the plunger, stuffing box, and packing must be compatible with the product being pumped.	• Diaphragm design allows pumping of abrasive and corrosive media without concern for wear, compatibility or replacement of packing or plunger/piston.

Hydra-Cell® Performance Advantages Compared to Other Types of Pumps

Magnetic Drive Pump Disadvantages:	Hydra-Cell Advantages:
• Running dry can result in damage to the pump.	• Seal-less design enables Hydra-Cell to run dry without damage to the pump.
• Requires monitoring to ensure fluid flow.	• Ensures proper fluid flow without monitoring.
• Designed to pump clean, low-viscosity fluids.	• Low-shear pumping action handles higher viscosity fluids.
• Higher power requirements and energy costs.	• More energy efficient.
• Can have a long horizontal footprint with higher acquisition and replacement costs.	• Smaller footprint compared to some magnetic drive pumps. • Easier to service. • Lower acquisition, operating and replacement costs.

Axial Piston Pump Disadvantages:	Hydra-Cell Advantages:
• Tight tolerances prevent use in fluids with particulates greater than 7 microns, especially with fluids that react with air and form crystals in the fluid.	• Tolerances are not an issue because the seal-less design and spring-loaded, horizontal disk check valves enable Hydra-Cell to pump solids, abrasive fillers and particulates up to 800 microns in size (depending on pump model).
• Filter and fluid reservoir necessary to maintain fluid cleanliness.	• Inherently simple design separates the lubricating film from the pumped fluid.
• Cylinder barrel can separate from valve plate, causing loss of lubricating film and damage to the barrel or plate.	• Requires no external filtration of pumped fluids.
• Back pressure can cause seal failure and mechanical damage.	• No packing and seal-less design, so it will not leak from seal failure.

Internal Gear Pump Disadvantages:	Hydra-Cell Advantages:
• Mechanical seals and packing require maintenance, and replacement or adjustment.	• The seal-less design of Hydra-Cell means that there are no mechanical seals or packing to leak or replace.
• Does not tolerate thin/non-lubricating liquids, and does not handle solids, abrasives or particulates well.	• Seal-less pumping chamber and spring-loaded, horizontal disk check valves can pump solids, abrasive fillers and particulates while handling liquids thick or thin.
• Designed for operating at low speeds and low pressure ratings. • Low volumetric efficiency.	• Operates at low-to-high speeds and at higher pressures with higher volumetric efficiency.
• Component wear reduces accuracy and efficiency.	• No internal gears to wear so there is less maintenance and spare part replacement. • Accuracy and efficiency are more stable.
• One bearing runs in the pumped fluid.	• No bearings in the pumped fluid.
• Unbalanced - overhung load on the shaft bearing.	• Hydraulically balanced design so there is no overhung load.

Versatile Hydra-Cell pumps can be equipped with Stainless Steel manifolds and ANSI flanges as well as non-metallic pump heads for handling highly aggressive or corrosive fluids used in water and wastewater treatment or RO.

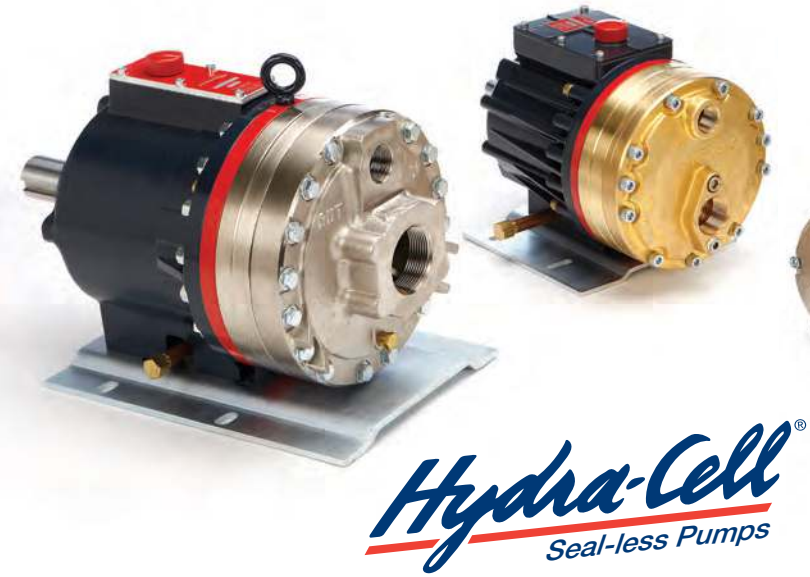
External Gear Pump Disadvantages:	**Hydra-Cell Advantages:**
• Mechanical seals and packing require maintenance, and replacement or adjustment.	• The seal-less design of Hydra-Cell means that there are no mechanical seals or packing to leak or replace.
• Does not tolerate solids, abrasives, or particulates.	• Seal-less pumping chamber and spring-loaded, horizontal disk check valves can pump solids, abrasive fillers and particulates.
• Component wear reduces accuracy and efficiency.	• No internal gears to wear so efficiency is more stable and there is less maintenance and spare part replacement.
• Contains four bushings/bearings in the fluid area.	• No bushings/bearings in the pumped fluid.
• Fixed end clearances are typical.	• Design does not rely on clearances.
• Efficiency drops as outlet pressure increases.	• Efficiency remains relatively constant over its range of operating pressures.
• Depends on pumped liquid for lubrication.	• Seal-less design does not require pumped liquid for lubrication.

Progressive Cavity Pump Disadvantages:	**Hydra-Cell Advantages:**
• Dynamic seals are worn by pumping abrasive fluids.	• No dynamic seals in the pumped fluid; can handle abrasive fluids reliably.
• Hydrodynamic film between the stator and rotor cam breaks down under pressure, reducing flow rate and negating true positive displacement pumping action.	• Seal-less pump chamber with hydraulically-balanced diaphragms mean that flow rate is maintained even as discharge pressure increases.
• Running dry can result in damage to the pump.	• Seal-less design enables Hydra-Cell to run dry without damage to the pump.
• Higher pressure requires additional stages with an increasing footprint for horizontal pumps.	• Can meet the same flow and pressure requirements with a much smaller footprint, saving space as well as investment and operation costs.

Peristaltic Pump Disadvantages:	**Hydra-Cell Advantages:**
• Require expensive pulsation dampeners to minimize pulsations.	• Multiple-diaphragm design provides virtually pulse-free flow, so expensive pulsation dampeners may not be required.
• Pump tube operates under stress, leading to failure and the expense of spare parts, maintenance, and repair.	• Diaphragms operate in hydraulic balance and are not under stress, thus providing long service life.

Hydra-Cell Positive Displacement Diaphragm Pumps are Ideal for Handling Abrasives and Particulates

DESIGNED & BUILT IN THE USA SINCE 1973



- Unmatched versatility for a wide range of pumping applications required in the water and wastewater as well as RO, nano-filtration, and ultra-filtration industries.
- Features a seal-less design and horizontal disk check valves that enable the pump to handle abrasives and particulates that might damage or destroy other types of pumps.
- Simple, compact design reduces initial investment and lowers maintenance costs.
- Variety of models that can operate with very low to very high flow rates and discharge pressures up to 2500 psi.
- Available in a wide range of pump head materials of construction and diaphragm materials.
- Variety of options and accessories to optimize performance.

Flow Capacities and Pressure Ratings

Model[1]	Maximum Capacity gpm (l/min)	Maximum Discharge Pressure psi (bar) Non-metallic[2]	Maximum Discharge Pressure psi (bar) Metallic	Maximum Operating Temperature F (C)[3] Non-metallic[2]	Maximum Operating Temperature F (C)[3] Metallic	Maximum Inlet Pressure psi (bar)
F20	1.0 (3.8)	350 (24)	1500 (103)	140˚ (60˚)	250˚ (121˚)	250 (17)
M03	3.1 (11.7)	350 (24)	1200 (83)	140˚ (60˚)	250˚ (121˚)	250 (17)
D04	2.9 (11.2)	N/A	2500 (172)	N/A	250˚ (121˚)	500 (34)
D10[4]	4.3 (15.1)	N/A	1500 (103)	N/A	250˚ (121˚)	250 (17)
D10	8.8 (33.4)	350 (24)	1500 (103)	140˚ (60˚)	250˚ (121˚)	250 (17)
D12	8.8 (33.4)	N/A	1000 (69)	N/A	250˚ (121˚)	250 (17)
D15 & D17	15.5 (58.7)	N/A	2500 (172)	N/A	250˚ (121˚)	500 (34)
H25	20.0 (75.9)	350 (24)	1000 (69)	140˚ (60˚)	250˚ (121˚)	250 (17)
D35[5]	23.1 (87.5)	N/A	1500 (103)	N/A	250˚ (121˚)	250 (17)
D35	36.5 (138)	N/A	1200 (83)	N/A	250˚ (121˚)	500 (34)
D66	68.5 (259)	250 (17)	700 (48)	140˚ (60˚)	250˚ (121˚)	250 (17)

1 Ratings are for cam design with the highest flow rate.
2 350 psi (24 bar) maximum with PVDF liquid end; 250 psi (17 bar) maximum with Polypropylene liquid end.
3 Consult factory for correct component selection for temperatures from 160˚F (71˚C) to 250˚F (121˚C).
4 D10 @790 rpm maximum.
5 D35 @700 rpm maximum.

For complete specifications and ordering information, consult the Hydra-Cell catalog.

Options and Accessories to Optimize Performance

Liquid end materials (manifolds)

For RO systems used to treat chemical waste streams, several metallic and non-metallic liquid end materials are available:

Metallic

- Brass
- Bronze
- Cast Iron (Nickel-plated)
- Hastelloy®C
- Duplex Alloy 2205 Stainless Steel
- 304 Stainless Steel
- 316L Stainless Steel

Non-metallic

- Polypropylene
- PVDF

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

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

Treated internal surfaces

Internal surfaces in contact with the liquid can be polished to the following specifications:

- 0.8 Ra
- 0.6 Ra
- 0.4 Ra

Diaphragm and o-ring materials

Diaphragms and corresponding o-rings are available in several elastomeric materials to suit required performance conditions:

- Aflas diaphragm (used with PTFE o-rings)
- Buna-N
- EPDM (requires EPDM-compatible oil)
- Neoprene
- PTFE
- FKM

Pipe connections

Simple threaded connections.

Flanged connections.

Hydra-Cell Metering Pumps Exceed API 675 Standards and Provide "Pulse-free" Linear Flow

IChemE 2007 Honourable Mention

The IChemE Awards recognize innovation and excellence in making outstanding contributions to safety, the environment, and sustainable development in the chemical and bioprocess industries.

Hydra-Cell® METERING SOLUTIONS™

- Designed for use with Variable Frequency Drive (VFD) electronic flow control to maintain greater accuracy throughout the turndown range.
- Multiple-diaphragm design (except the P100) provides virtually pulse-free flow, eliminating the need to purchase expensive pulsation dampeners.
- Offers all the features and benefits of Hydra-Cell Seal-less Pumps (F/M/D/H Series) including seal-less design, Horizontal disk check valves, and space-saving, compact design.
- Variety of models that can operate with very low to very high flow rates and discharge pressures up to 2500 psi.
- Available in a wide range of pump head materials of construction and diaphragm materials.
- Every model is available with a variety of gear box ratios to meet your application needs.
- Variety of options and accessories to optimize performance.

Flow Capacities and Pressure Ratings

Model[1]	Maximum Capacity gph	Maximum Discharge Pressure psi (bar)		Maximum Operating Temperature F (C)[3]		Maximum Inlet Pressure psi (bar)
		Non-metallic[2]	Metallic	Non-metallic[2]	Metallic	
P100	27.0	350 (24)	1500 (103)	140˚ (60˚)	250˚ (121˚)	250 (17)
P200	81.0	350 (24)	1000 (69)	140˚ (60˚)	250˚ (121˚)	250 (17)
P300	81.4	N/A	2500 (172)	N/A	250˚ (121˚)	500 (34)
P400	242.8	350 (24)	1000 (69)	140˚ (60˚)	250˚ (121˚)	250 (17)
P500	425.9	N/A	2500 (172)	N/A	250˚ (121˚)	500 (34)
P600	890.3	350 (24)	1000 (69)	140˚ (60˚)	250˚ (121˚)	250 (17)

1 Ratings are for X-cam design.
2 Consult factory for ratings in liters per hour (lph).
3 350 psi (24 bar) maximum with PVDF liquid end; 250 psi (17 bar) maximum with Polypropylene liquid end.
4 Consult factory for correct component selection for temperatures from 160˚F (71˚C) to 250˚F (121˚C).

For complete specifications and ordering information, consult the Hydra-Cell metering pumps catalog.

Options and Accessories to Optimize Performance

In addition to options and accessories offered with Hydra-Cell Seal-less Pumps, Hydra-Cell Metering Solutions pumps are available with specialized components to enhance your metering and chemical-feed systems.

Calibration cylinders

Available in glass and PVC, calibration cylinders verify the flow rate of your P Series metering pump, providing a visual indicator that your system is operating within the required parameters for performance and accuracy.

Back pressure and pressure relief valves

Back pressure valves help ensure that your system provides accurate and predictable flow. Pressure relief valves protect your pump and system from over-pressurized situations. They are available in a choice of wetted materials with PTFE diaphragms,

Control Freak™ touch-screen metering controller

"Control Freak" is an exclusive new electronic controller that provides motor speed control for Hydra-Cell Metering Solutions pumps (or Hydra-Cell bare shaft pumps for metering). It features an easy-to-use touch-screen display and built-in programming.

The user can enter the desired flow rate or volume in gallons or liters and system pressure in psi or bar, and the controller automatically runs the pump manually at the desired flow rate or volume total/time, or in pre-set batches.

Other options and accessories

- Manifolds and Flanges
- Multiplexing Capability
- Different Gearbox Ratios
- Oil Systems and Kits
- Different Actuating Oils
- Motors (Standard/Explosion-proof)
- Controllers
- SmartDrive Motor-Controller
- Pulsation Dampeners

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Seal-less Pumps

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