Hydra-Cell®

Seal-less Pump Technology

Chemical and Petrochemical Process

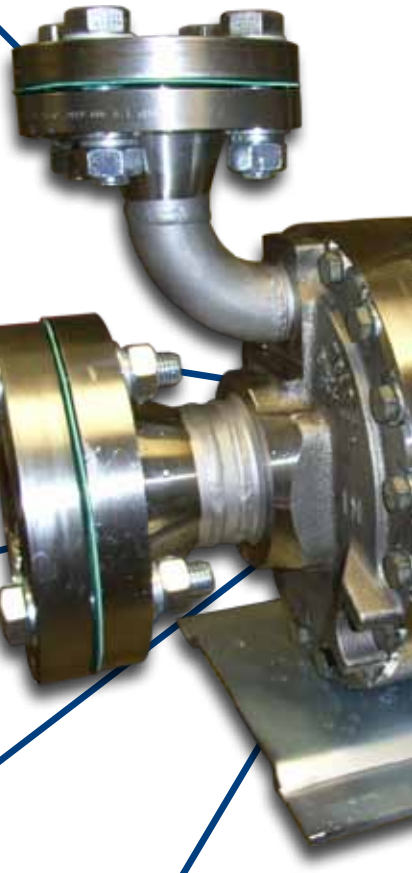
Rugged reliability with precision

Chemical and Petrochemical - with Dosing, injection, metering, spraying and transfer

Compact seal-less Hydra-Cell® pumps for long life and high reliability.

Metering and Dosing

- Virtually pulse-less flow, enabling removal of pulsation dampeners and reducing pipe strain, meeting and exceeding the performance requirements of API 675



CIP Cleaning

- High pressure for high energy impinging spray cleaning, even with hot recycled liquids

Spray Drying

- Efficient and reliable handling of liquids with dissolved and undissolved solids, viscous or abrasive liquids

Flare Stack Burning

- Complete containment of liquid hydrocarbons

Reverse Osmosis

- Concentrating organic chemicals and reducing waste streams

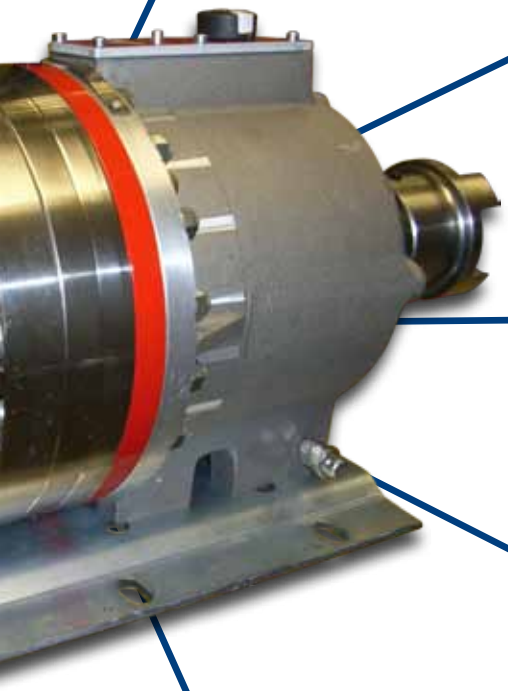
With over 35 years experience in serving the chemical and petrochemical industry, including many of the major global chemical companies, Hydra-Cell® pumps have proven performance in efficiently pumping the widest range of chemicals and petrochemicals including corrosive, hot, abrasive, viscous, non-lubricating, recycled, shear sensitive and liquids containing solids. Their unique multi-diaphragm, seal-less design provides 100% safe containment for even the most aggressive liquids.

Pressure Injection and Mixing

- Easily controlled high pressure flow for injection and impingement mixing

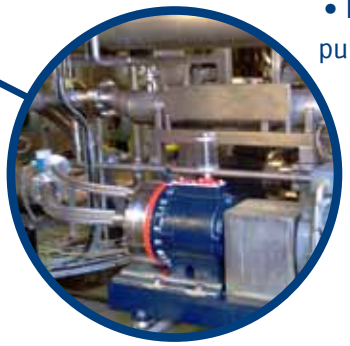
Emissions Control

- Efficient and reliable handling of non-lubricating liquids with dissolved and undissolved solids



Sampling

- Highly accurate, with virtually pulseless flow, enabling removal of pulsation dampeners



Filtration

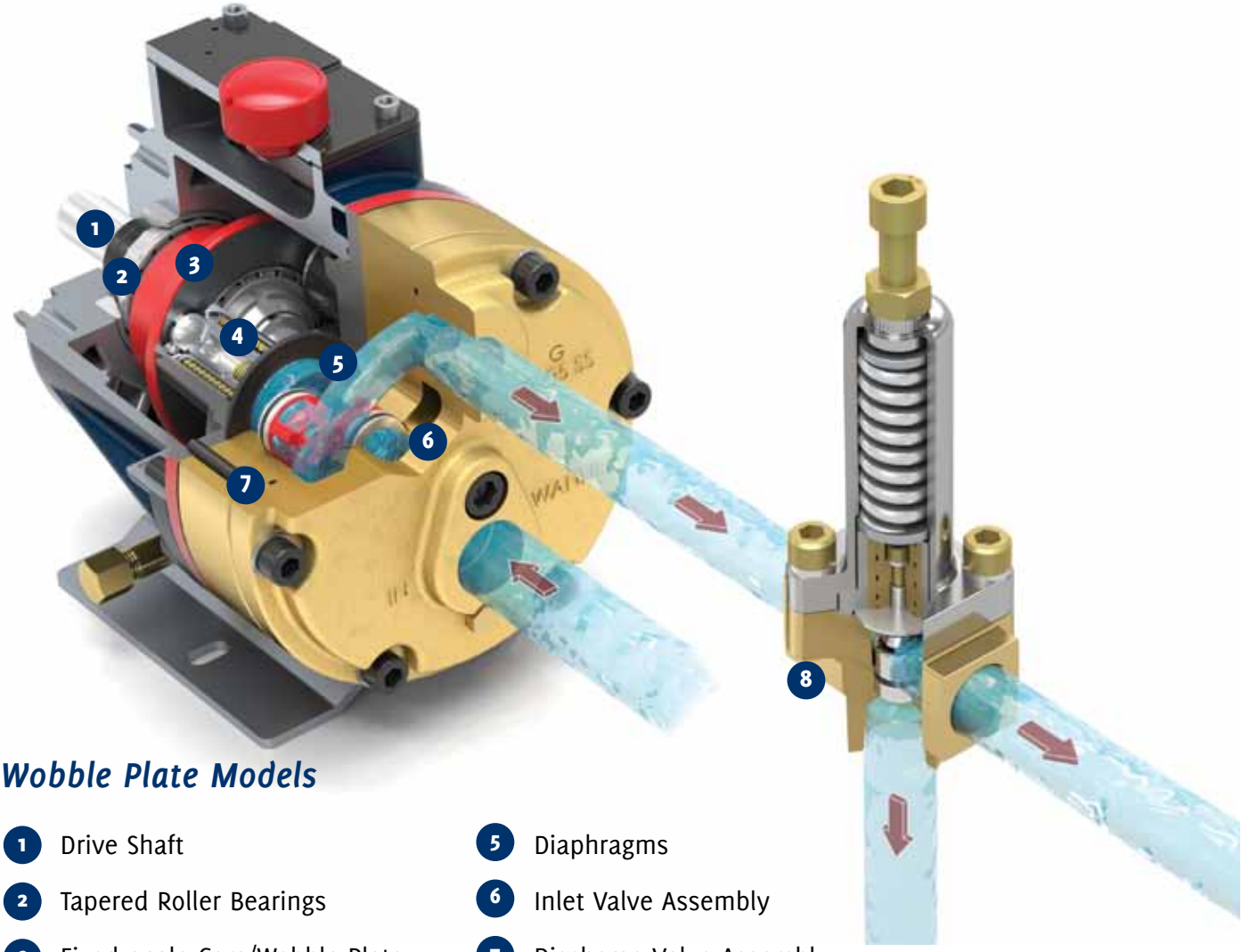
- High pressure charging of filter presses with particulate matter

Liquid Transfer

- High efficiency / low energy consumption

Typical Chemicals and Liquids Pumped	Challenges in Pumping	The Hydra-Cell® Advantage
Acids Sulphuric, Hydrochloric, Nitric plus many more	• Crystallisation can occur under certain conditions creating solids in the liquid • Aggressive & corrosive	• Horizontal check valves can handle liquids with undissolved solids • No dynamic seals. Can pump corrosive liquids
Caustics Sodium Hydroxide, Potassium Hydroxide	• Crystallisation can occur under certain conditions creating abrasive solid particles	• Horizontal check valves can handle liquids with undissolved solids
Deionised Water	• Non-lubricating and aggressive	• No dynamic seals that need to be lubricated by the process liquid
Hot Liquids	• Higher temperatures have a dramatic effect on speeding up corrosion rates	• No dynamic seals means that the Hydra-cell® pump can handle liquids with temperatures up to 120 °C
Hydrocarbons	• Non lubricating • Thin, very low viscosity liquids search for leak paths	• No dynamic seals that need to be lubricated by the process liquid • No dynamic seals to leak. Pumped liquid is 100% contained
Polymers	• May shear thin easily, breaking down the chemistry • May flocculate if exposed to excessive temperatures	• Low shear pumping action • Minimal heat transfer from the pump to the process liquid
Proprietary Chemicals	• Complex chemistry may mean exotic materials are needed for the pump head	• Compact design with easily interchangeable liquid end parts gives the flexibility to handle the most demanding duties cost-effectively and reliably
Recycled Liquids	• Contains solid particles which can damage dynamic seals and cause problems with some valve designs	• No dynamic seals or tight tolerances sitting in the process liquid to be damaged by the solid particles. • Horizontal check valves can handle liquids with non-dissolved solids reliably
Resins	• Exposure to air can cause crystallisation • Viscous liquids	• No dynamic seals to leak air into pump liquid or to be damaged by solid abrasive particles • Can handle high viscosity liquids
Slurries	• Contains abrasive non-soluble particles	• No dynamic seals to be damaged by abrasive solids
Solvents	• Non lubricating	• No dynamic seals that need to be lubricated by the process liquid
Waste Chemical Streams	• May contain non-lubricating corrosive liquids with non-dissolved particles	• No dynamic seals to be damaged by process liquid

Hydra-Cell® Principles of Operation - Wobble Plate



Wobble Plate Models

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

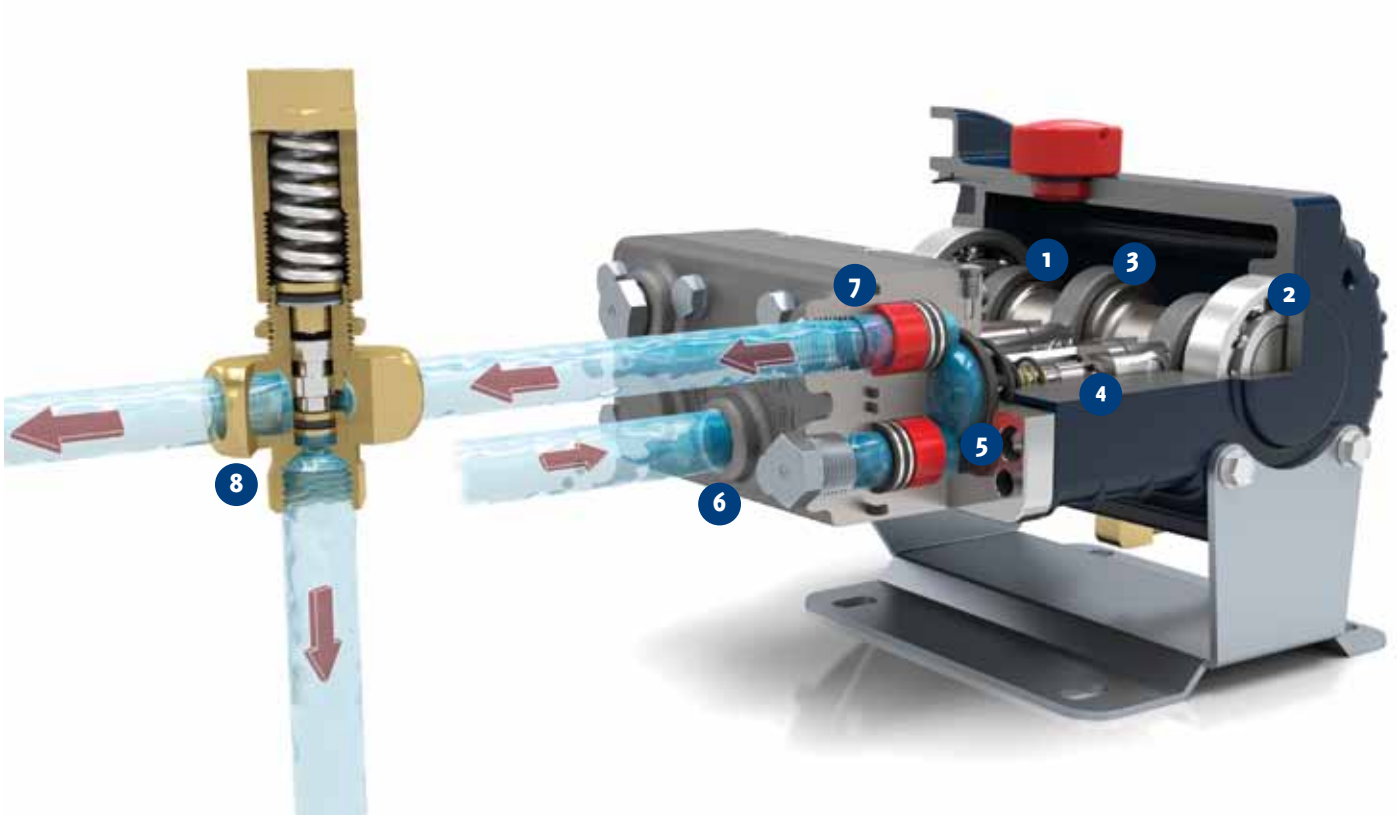
The oil held in the Hydra-Cell balances the back side of the diaphragms (5) and causes the diaphragms to flex forward and back as the Wobble plate moves. This provides the pumping action.

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.

Hydra-Cell® Principles of Operation - Crankshaft



Crank-shaft Models

1. Drive Shaft
2. Precision Ball Bearings
3. Connecting Rods
4. Hydraulic Cells (Patented)
5. Diaphragms
6. Inlet Valve Assembly
7. Discharge Valve Assembly
8. C46 Pressure Regulating Valve (In-line)

Reliable, Efficient Pumping Action

The drive shaft (1) is supported in position by two precision ball bearings (2) positioned at either end of the shaft. Located between these bearings are either one or three cam shaft lobes with connecting rods (3) that are hardened, precision ground, and polished. Maintaining a high level of quality on the cam lobes and connecting rod surfaces ensures proper lubrication and reduced operating temperatures in the hydraulic end of the pump.

As the drive shaft turns, each cam actuates the attached connecting rod that is pinned into position at the end of each hydraulic piston. This action moves the piston forward and backward, converting the axial motion into linear pumping motion. The complete pumping mechanism is submerged in a lubricating oil bath.

Each piston contains a patented hydraulic cell (4) that is moved sequentially by the crank-shaft. The innovative and proprietary Hydra-Cell maintains the precise balance of oil behind the diaphragm (5) regardless of the operating conditions of the pump. The oil in Hydra-Cell is pressurized on the forward stroke of the piston causing the diaphragm to flex, which drives the pumping action. The oil held in the Hydra-Cell balances the diaphragm against the liquid being pumped, maintaining no more than a 0.21 bar differential regardless of the pressure at which the liquid is being delivered - up to 172 bar on standard Hydra-Cell models and Hydra-Cell metering pumps.

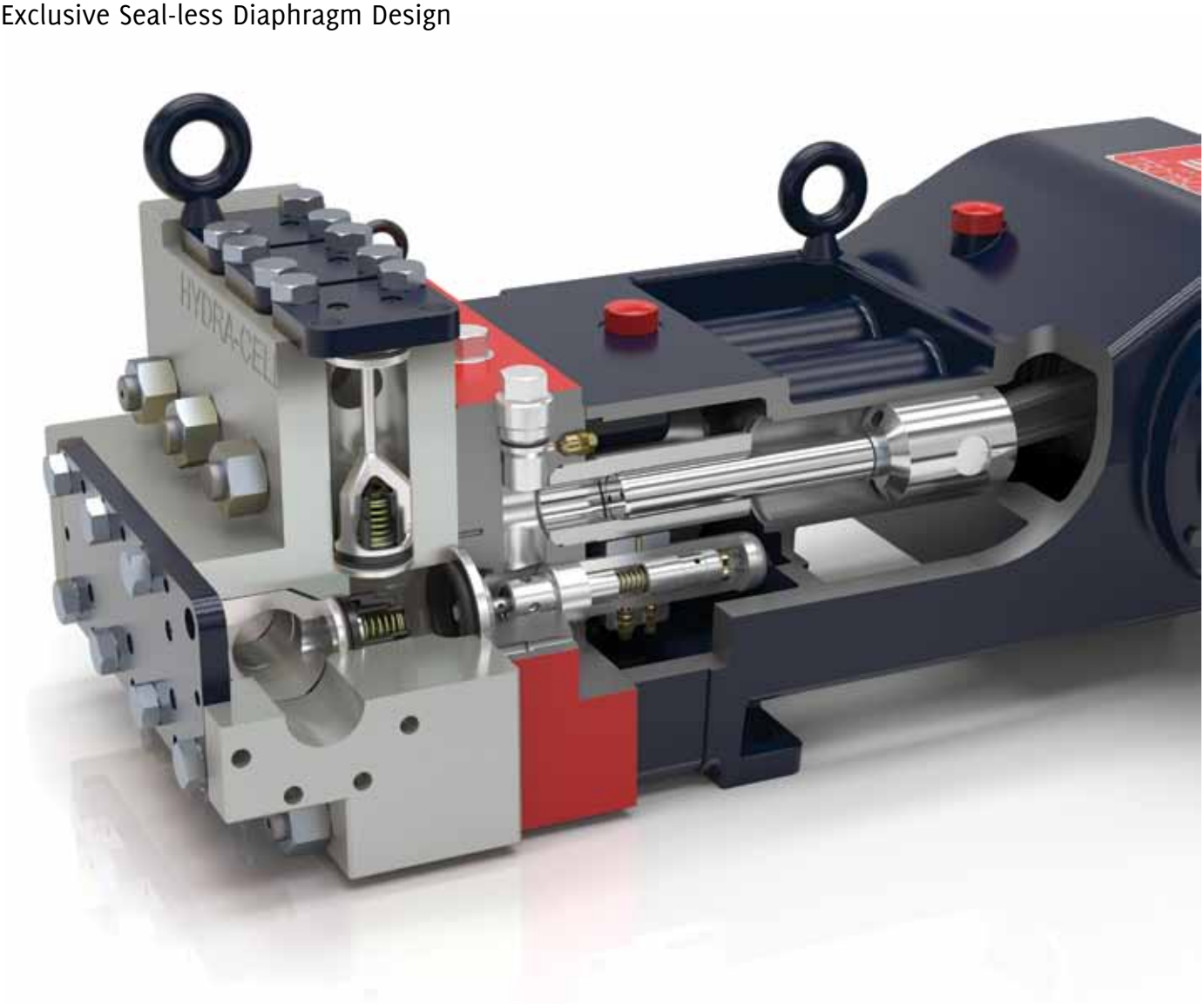
Hydra-Cell crank-shaft pumps can have up to three diaphragms, and each diaphragm has its own pumping chamber that contains an inlet and discharge self-aligning horizontal disk check valve assembly (6). As the diaphragms move back, liquid enters the pump through a common inlet and passes through one of the inlet check valves. On the forward stroke, the diaphragm forces the liquid out of 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 C46 pressure regulating valve (8) is typically installed on the discharge side of the pump to regulate the pressure of downstream process or equipment.

Hydra-Cell® Principles of Operation - T Series

API 674 option available

Exclusive Seal-less Diaphragm Design



- Seal-less design separates the power end from the process liquid end, eliminating leaks, hazards, and the expense associated with seals and packing
- Low NPSH requirements allow for operation with a vacuum condition on the suction - positive suction pressure is not necessary
- Can operate with a closed or blocked suction line and run dry indefinitely without damage, eliminating downtime and repair costs
- Unique diaphragm design handles more abrasives with less wear than gear, screw or plunger pumps
- Hydraulically balanced diaphragms to handle high pressures with low stress
- Provides low-pulse, linear flow due to its multiple diaphragm design
- Lower energy costs than centrifugal pumps and other pump technologies
- Rugged construction for long life with minimal maintenance
- Compact design and double-ended shaft provides a variety of installation options
- Hydra-Cell T-Series pumps can be configured to meet API 674 standards – consult factory for details

Hydra-Cell T80 Series pumps received a "Spotlight on New Technology" award from the Offshore Technology Conference.

Hydra-Cell® advantages

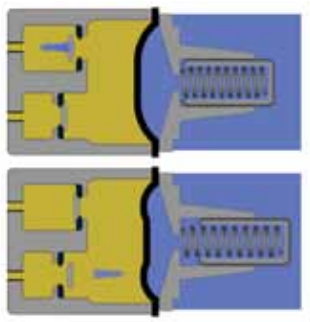
Designed for continuous use, Hydra-Cell® multi-diaphragm pumps are robust, reliable and efficient and cover a wide variety of chemical pumping applications. In continuous process, Hydra-Cell's® compact size, low maintenance, high efficiency, seal-less design all lead to low total cost of ownership.

High pressure pipe flushing with 110°c water to remove sulphur build-up

High reliability... low maintenance

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

- Run dry indefinitely
- No seals to wear
- No seals to leak any potentially harmful chemicals
- No seals to leak any Volatile Organic Compounds
- No tight tolerances that could be susceptible to corrosion or damaged by solid particles
- Pumps liquids with viscosities from 0.01 to 6000 cSt
- Pumps non-lubricating liquids reliably
- Pumps liquids with up to 500µm dia. particulate matter
- No 'drop-off' in performance due to seal wear



Hydra-Cell® pumps have no packing

Compact design

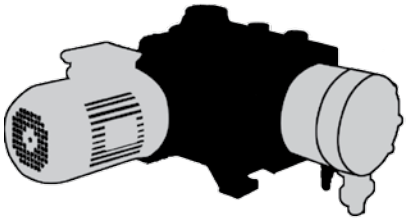
For metering and dosing applications Hydra-Cell®'s compact design gives real advantages.

1. Space saving
2. Easier servicing
3. Lower initial purchase cost

Both pumps are rated at 172 Bar and 110 l/hr

◀ Hydra-Cell®
Weight 23 kg

Traditional metering pump
Weight 100 kg ▼



Hydra-Cell® size compared with a traditional metering pump

Unique horizontal check valves ▶

- Reliably pump acids, resins and caustics which crystallise.
- Efficient pumping of liquids with solids such as lime slurries, spray drying slurries containing non-dissolved solids.

Hydra-Cell® valve assemblies (cut-away view)

Low shear pumping action

Due to the gentle pumping action, shear sensitive liquids, especially polymers, can be pumped without breaking down the long chain structures within the liquids.

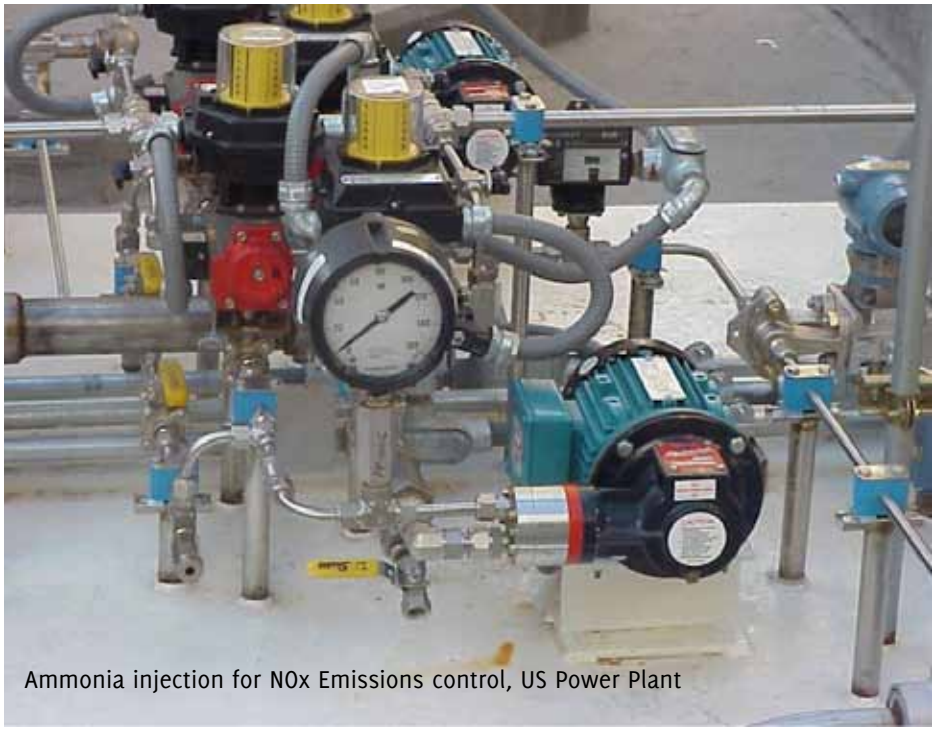
Simple robust design

- Designed and built for long service life.
- Simple maintenance with no special tool requirements.
- No critical tolerances to be aware of during maintenance.
- On-site repair possible, no costly requirement for removal and transportation to workshops.

Feeding hydrogenation reactor, Brazil

Minimal filtration

- No mechanical seals or tight tolerances that need protection by fine filtration. Hydra-Cell® pumps can handle particles up to 500 µm, depending on model. Also liquids with non-dissolved solids up to 40%, depending on particle distribution.
- Unaffected by lapses in filtration reducing costly pump repairs.
- Reduced filtration maintenance and management.



Ammonia injection for NOx Emissions control, US Power Plant

Energy saving

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

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

Flow (m^3/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 (m^3/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

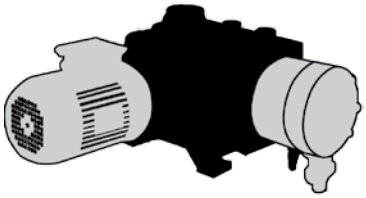
High efficiencies

- A true positive-displacement pump, Hydra-Cell® is one of the most efficient metering and dosing pumps available.

Both pumps are rated at 172 Bar and 110 l/hr

◀ Hydra-Cell® metering pump
Motor 0.75 kW (€60)

▼ Traditional
Metering pump
Motor 4 kW (€180)



Save up to 65% on motor costs

Hydra-Cell® multiple diaphragm head means smaller motors can be used, saving energy.

Injection of proprietary monomers and inhibitors, China

Nano filtration process for food additive manufacturer, Germany

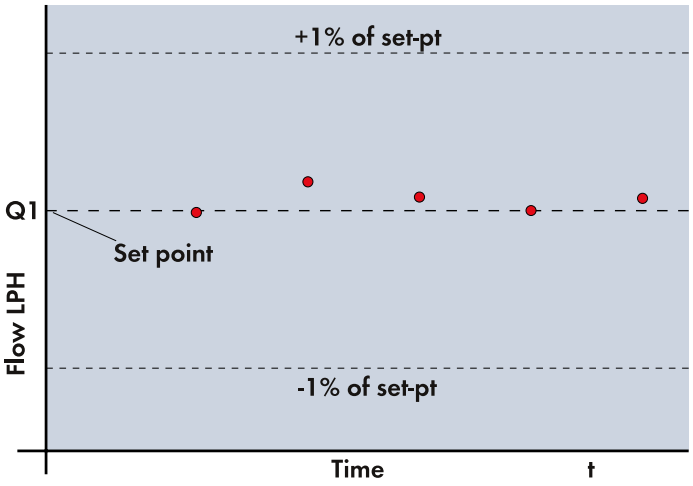
Metering Bio-diesel additive, Czech

Pressure injecting liquid containing 30% non-dissolved titanium dioxide in De ionised water, Germany

Ultimate Controllability for Metering and Dosing

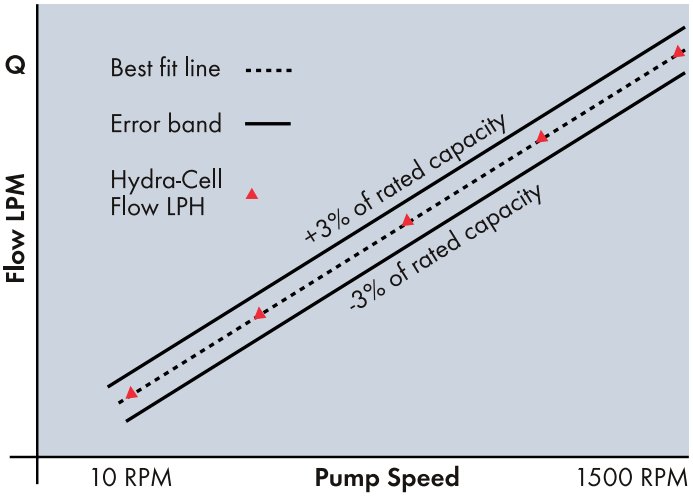
Metering & dosing exceeding the performance requirements of API675.

- **Steady state accuracy** better than +/- 1%



This is a measure of how well a set flow rate can be maintained.

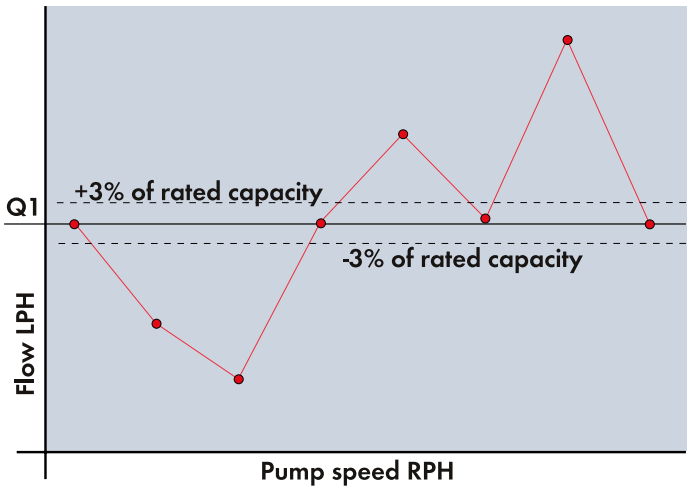
- **Linearity** (Pump shaft speed/flow rate relationship) better than +/- 3%



This is a measure of how accurate the flow rate can be set by changing and setting pump speed.


Polymer dosing for water treatment, USA

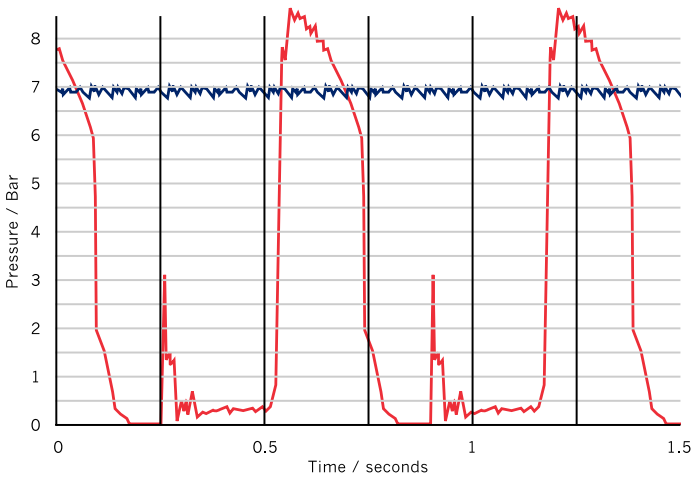
- **Repeatability** better than +/- 3%



This is a measure of how accurate the flow rate can be controlled when varying the pump shaft rpm away from a set point and returning to that set point.

Virtually pulse-less flow for accurate metering

- Pulsation dampeners may not be required for most Hydra-Cell® pumps.
- More accurate control of flow rate and efficient use of chemicals.
- Significantly less inlet acceleration head issues than traditional single diaphragm metering pumps, especially with viscous liquids.



Hydra-Cell® pumps

Leading brand metering pump

Hydra-Cell® Performance Advantages

Traditional 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.

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 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, unique spring-loaded 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.
• Bearings & bushes run in the pumped liquid.	• No bearings in the pumped liquid.
• Unbalanced - overhung load on the shaft bearing.	• Hydraulically balanced design so there is no overhung load.
• Fixed end clearances.	• Design does not rely on clearances.
• Efficiency drops over 103 bar.	• Efficiency remains relatively constant over its range of operating pressures.

Progressing Cavity Pump Disadvantages	Hydra-Cell® Advantages
• Dynamic seals are worn by abrasive liquids	• No dynamic seals in the pumped liquid can handle abrasive liquids reliably
• Hydrodynamic film between the stator and rotor can break down under pressure reducing flow rate and not producing a true positive displacement pump action.	• Seal-less pump chamber with hydraulically balanced diaphragms means that flow rate is maintained even as discharge pressure increases

Plunger Pump Disadvantages	Hydra-Cell® Advantages
• Cannot run dry without damage to the pump.	• Seal-less design enables the pump to run dry without damage.
• Requires fine filtration to protect dynamic seals.	• No dynamic seals to protect no need for fine filtration to protect the pump. Recycled liquids and liquids containing particle can be pumped reliably.
• Hot liquids can damage packing and seals.	• No dynamic seals can handle hot liquids reliably.
• All dynamic seals deigned to leak resulting in crank oil contamination by process liquid resulting in frequent oil changes.	• Crank oil and process liquid are completely separated resulting in significantly low frequency of oil change.

Peristaltic Pump Disadvantages	Hydra-Cell® Advantages
• Pulsing flow on discharge pulsation dampers required.	• Multiple diaphragm pump head ensures smooth discharge flow. Pulsation dampers not required on the majority of applications.
• Pump tube operates under stress leading to a consumable replacement part.	• Diaphragms operating in hydraulic balance under no stress leading to long life.

Magnetic Drive Pump Disadvantages	Hydra-Cell® Advantages
• Cannot run dry without damage to the pump.	• Seal-less design enables Hydra-Cell® to run dry without damage.
• Requires monitoring to ensure liquid flow.	• Ensures proper liquid flow without monitoring.
• Designed to pump clean, low-viscosity liquids.	• Seal-less pumping chamber and spring-loaded, horizontal disk check valves can handle particulates and abrasive fillers.
• Higher power requirements and energy costs.	• Low-shear pumping action handles higher viscosity liquids.
• Can have a long horizontal footprint with higher acquisition and replacement costs.	• Smaller footprint compared to some magnetic drive pumps. • More energy efficient. • Easier to service. • Lower acquisition, operating and replacement costs.

Pump selection

Hydra-Cell® G Series positive displacement diaphragm pumps for dosing, pressure injection, transfer, spraying

Hydra-Cell® G-series, heavy duty pumps are designed for transfer, pressure injection, dosing and spraying and have proven reliability in pumping aggressive, non-lubricating, corrosive, viscous, abrasive, hot liquids in many arduous applications.

Hydra-Cell®'s seal-less design provides no internal leak paths through which potentially harmful liquids or emissions could escape, ensuring 100% containment.

Available to Meet API 674!

Hydra-Cell® P-Series Extraordinary Metering Pumps - Exceeding API 675 performance standards

Designed for precision dosing of chemicals from 0.5 l/hr to 2500 l/hr when the high accuracy, control, simplicity and reliability of a hydraulically balanced diaphragm pump are needed.

Thanks to its modern design, the acquisition cost of Hydra-Cell® high precision metering and dosing pumps compare favourably with the cost of conventional metering pumps of similar performance.

Liquids that can crystallise and can cause damage to other pumps can usually be dosed very successfully and accurately with Hydra-Cell® P-Series pumps thanks to their inherently unique and ground-breaking design.

Hydra-Cell® T-Series High volume, high pressure process pumps

Available to Meet API 674!

Hydra-Cell T-series pumps have flow rates up to 170 l/min (45 gpm) for the T8045 and high pressures up to 345 bar (5000 psi) for the T8030 making them the 'workhorses' in high volume chemical processing.

With lowers energy use and costs compared to multistage centrifugal and many other pump technologies, Hydra-Cell® T-Series pumps are an indispensable choice for economical and environmentally sound operation.

Deionised water injection, Japan

Materials

A variety of liquid head materials and diaphragm materials are available to suit the pumped liquid and varying performance conditions.

Liquid Head Materials	Diaphragm Materials	Pump Housing Materials
Hastelloy CW12MW Super Duplex 2507 Duplex Alloy 2205 316L Stainless Steel Brass Cast Iron Polypropylene Kynar	EPDM FKM FFKM PTFE Neoprene Buna Aflas	Cast Aluminium Ductile Iron for G10, G25 and G35

Pipe connections

SAE flange connections

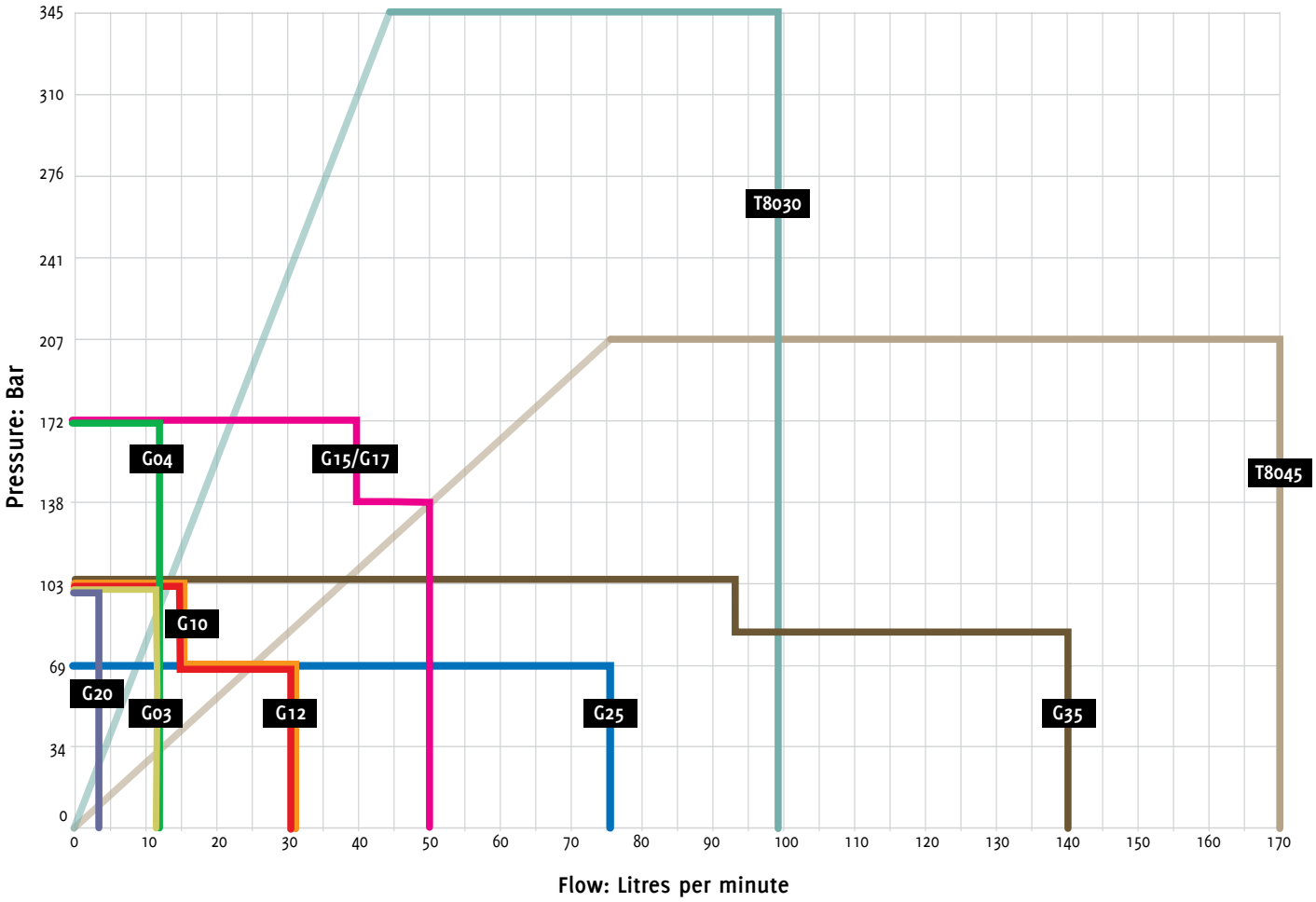
Specialised flange connections
e.g. Tri-Clamp®

Flanged connections

Simple threaded connections NPT or BSPT

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.

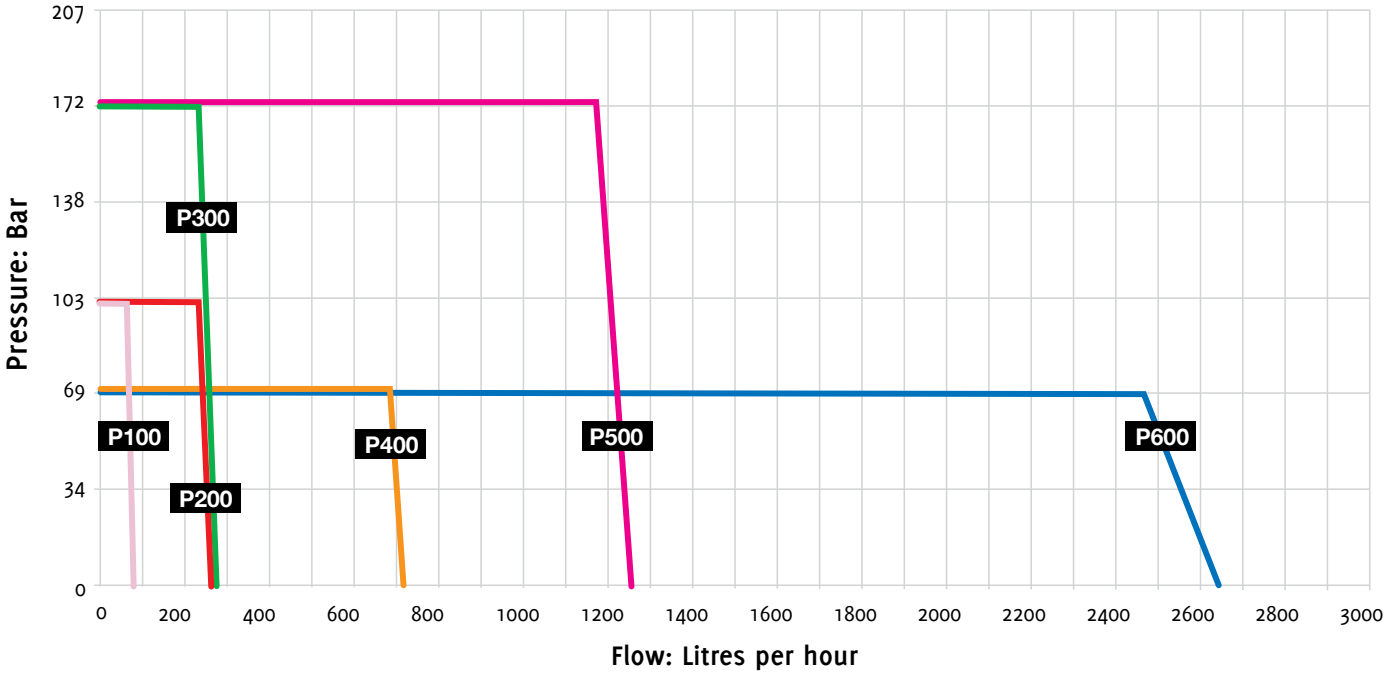
Model	Maximum Capacity l/min	Maximum Discharge Pressure bar		Maximum Operating Temperature °C[2]		Maximum Inlet Pressure bar
		Non-Metallic[1]	Metallic	Non-Metallic	Metallic	
G20	3.8	24	103	60°	121°	17
G03	11.7	24	103	60°	121°	17
G04	11.2	N/A	172	N/A	121°	34
G10	33.4	24	103	60°	121°	17
G12	33.4	N/A	103	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® P Series Flow Capacities and Pressure Ratings

P Series Electronic Precision Metering Pumps



Model[1]	Maximum Capacity l/hr	Maximum Discharge Pressure bar		Maximum Operating Temperature °C[3]		Maximum Inlet Pressure bar
		Non-Metallic[2]	Metallic	Non-Metallic[2]	Metallic	
P100	78.0	24	103	60°	121°	17
P200	237.4	24	103	60°	121°	17
P300	242.1	N/A	172	N/A	121°	34
P400	714.9	24	69	60°	121°	17
P500	1255.1	N/A	172	N/A	121°	34
P600	2634.0	24	69	60°	121°	17

1 *Ratings are for X-Cam design*
2 *24 bar maximum with PVDF (Kynar®) liquid end; 17 bar maximum with Polypropylene liquid end.*
3 *Consult factory for correct component selection for temperatures above 71˚C*

Hydra-Cell® P Series Pumps Exceed API 675 Performance Standards

Hydra Cell Metering Solutions pumps meet or exceed API 675 performance standards for Steady-State Accuracy (± 1%), Linearity (± 3%) and Repeatability (± 3%).

Hydra-Cell® Control Options

Electronic Control

- ATEX Dust Zone 21 (Ex tb III C T125c Db)
- IP55 Standard
- Flow adjustment scale via hand-wheel

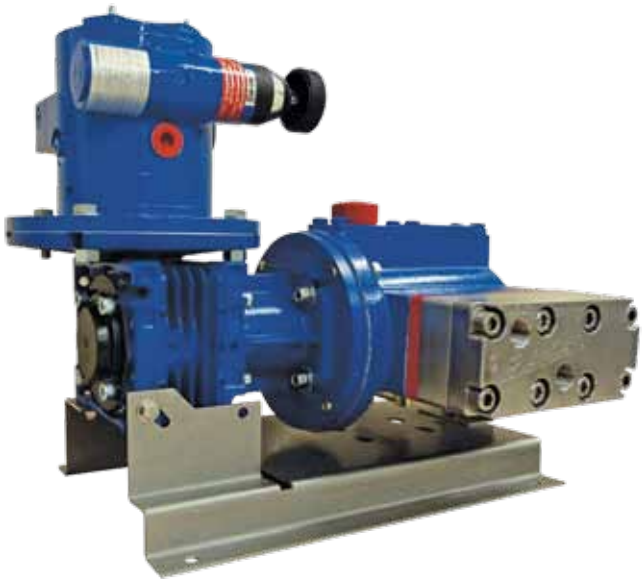
Control Freak

- Multiple Variable Frequency Dive (VFD) options
- Enables programming for flow rate or totalisation
- Option available to control multiple pumps with one Hydra-Cell “Control Freak”

Mechanical Adjustment

- ATEX Zone 1
- Linear fine adjustment scale on hand-wheel
- High reliability due to frictionless design

ATEX



Notes

WANNER

Hydra-Cell®

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