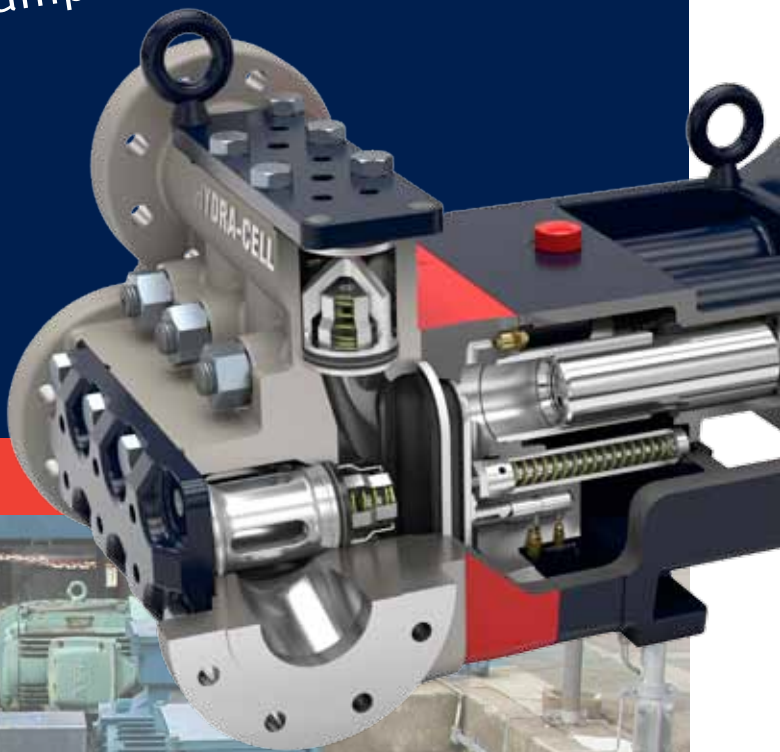
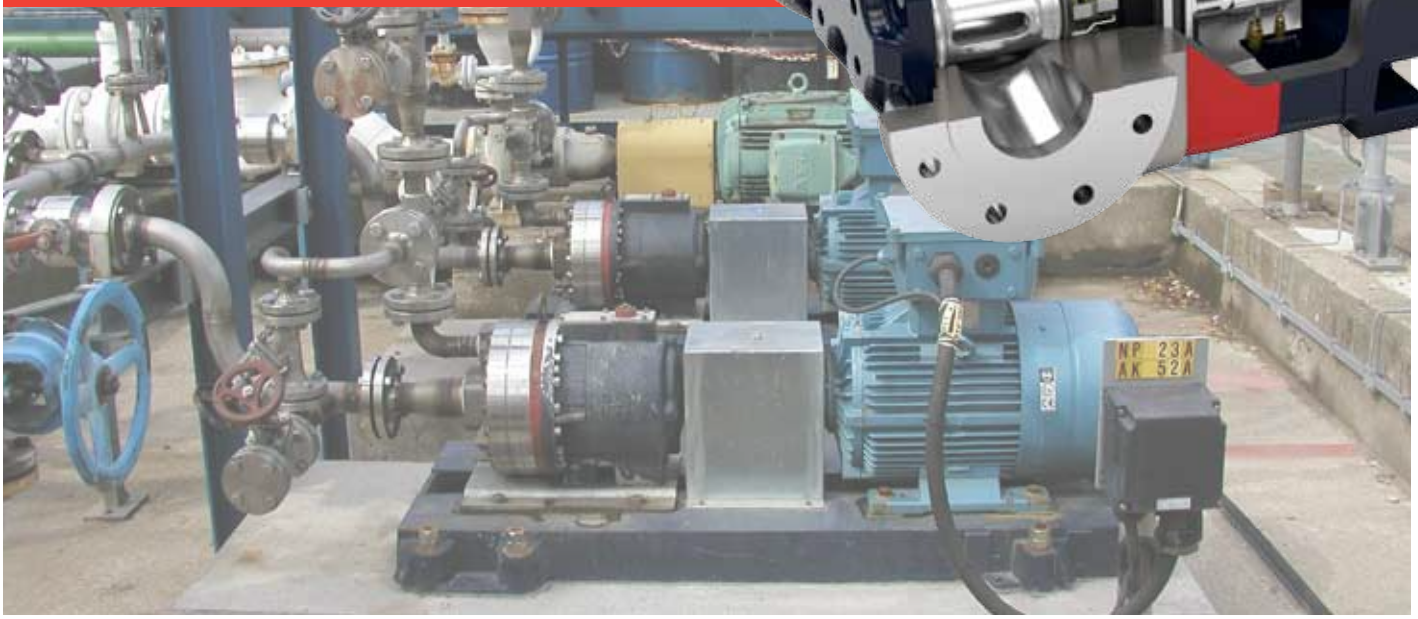
Hydra-Cell®

Seal-less Pump Technology

Chemical and Petrochemical Process

Rugged reliability with precision



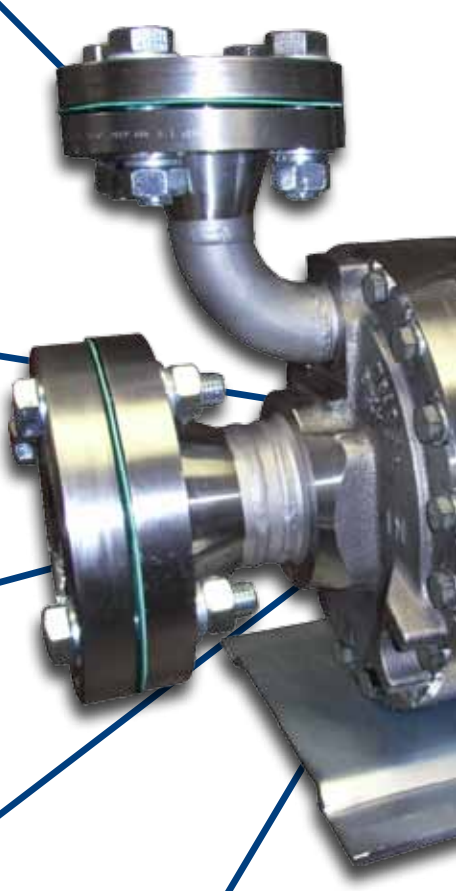


Chemical and Petrochemical - with dosing, injection, metering, spraying and transfer

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

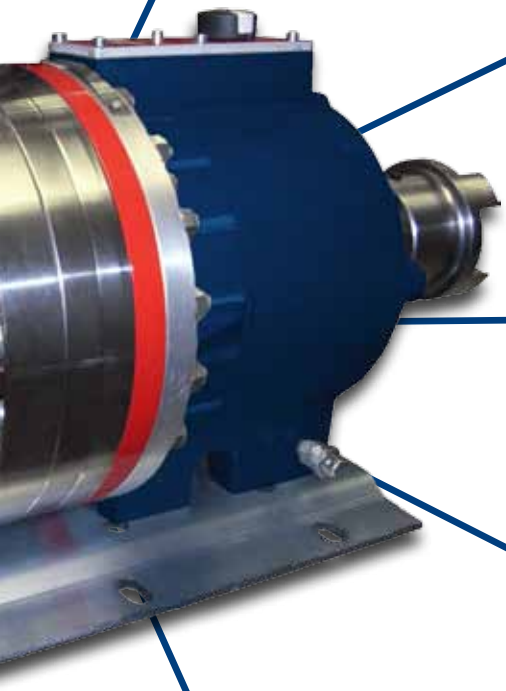
With over 40 years' experience in serving the chemical and petrochemical industry, including many of the major global chemical companies, Hydra-Cell® pumps have proven performance in efficiently pumping the widest range of chemicals and petrochemicals including corrosive, hot, abrasive, viscous, non-lubricating, 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

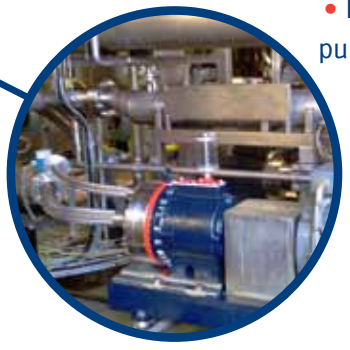
Emissions Control

- 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®

ADVANTAGES
LOWEST LIFE CYCLE COSTS

How does Hydra-Cell pump technology reduce life cycle costs?

Acquisition Cost:

Multiple diaphragms in a single pump head sequentially actuated results in a robust compact design reducing acquisition cost of pump and eliminates pulsation dampeners.

Seal-less design eliminates cost of any seal flushing systems.

Maintenance and Repair Costs:

Simple, clever design means any servicing or maintenance is carried out efficiently and at minimal cost. No packing. No dynamic seals to replace. No tight tolerances to set. No complicated mechanical mechanism to set.

An oil change, typically annually depending on duty, a liquid end kit (Typically $500 to $4000 depending on pump size & MoC) is all that is required.

Installation and Commissioning Costs:

Indefinite run dry capable and the ability to run with a closed suction line due to Diaphragm Position Control (DPC) means that operator's mistakes during commissioning are not costly.

The ability of the Hydra-Cell pump to handle liquids with particles saves expensive fine filtration costs.

Suction line charge pumps can be eliminated due to low NPSHr and dry lift priming.

Energy Costs:

The highest efficiency transfer, metering and dosing & pressure injection process pumps on the market with >20% savings with ultimate controllability to further save energy costs.

Environmental Cost:

Hydra-Cell's seal-less design means that the pumped liquid is 100% contained with no external leak paths, keeping operators and the environment safe.

Downtime and Loss of Production Costs:

Hydra-Cell's seal-less & low pulsation coupled with a unique check valve design to pump slurries and viscous liquids offers best in class performance, minimizing downtime and lost production.

Operating Cost:

Very low pulsed flow means pulsation dampeners are not required in most installations saving maintenance costs. Any pipe strain issues are also dramatically reduced eliminating cost due to piping repairs and lost chemicals due to leakage.

Seal & packing-less design means a very reliable pump giving many years of service without planned or unplanned downtime, saving on maintenance costs.

No dynamic seals eliminate any expense of seal flushing.

Decommissioning and Disposal Costs:

Many Hydra-Cells have been operating successfully for over 30 years with minimal servicing. 20 years plus service life means decommissioning and disposal costs are amortised over many years.

Hydra-Cell® ADVANTAGES AND FEATURES

Metering and Dosing | Process Pressure Injection | Spray Drying

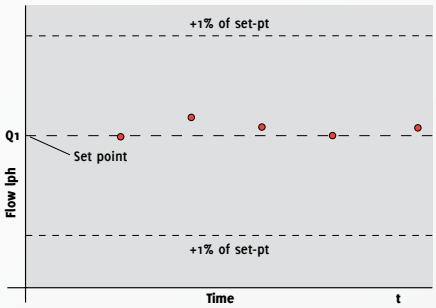
Eliminating wasted chemicals by improving control over your process

Hydra-Cell® pumps have proven performance in efficiently and reliably pumping the widest range of chemicals and petrochemicals including corrosive, hot, abrasive, viscous, non-lubricating, recycled, shear sensitive and liquids containing solids.

Hydra-Cell pumps exceed requirements for API675 performance standards

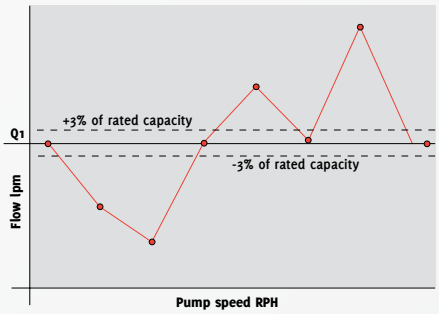
	G Series	P Series & M Series
Steady State Accuracy	<±1%	<±0.5%
Repeatability	<±3%	<±1%
Linearity	<±3%	<±1%

Steady state accuracy - Better than +/- 1%



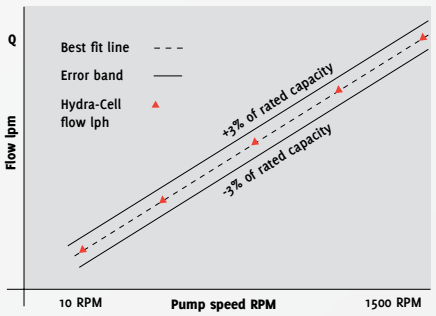
This is a measure of how well a set flow rate can be maintained.

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.

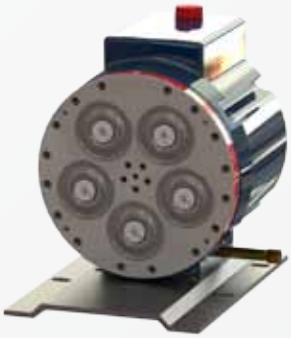
Linearity - (Pump shaft speed/flow rate relationship) better than +/- 3%

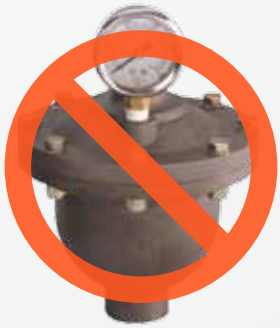


This is a measure of how accurate the flow rate can be set by changing and setting pump speed.

Reliable steady state accuracy without service & maintenance

Hydra-Cell's multi diaphragm pump head means that pulsation dampeners are not needed in most applications; saving on acquisition, maintenance and service costs and ensuring a more consistent and accurate process.

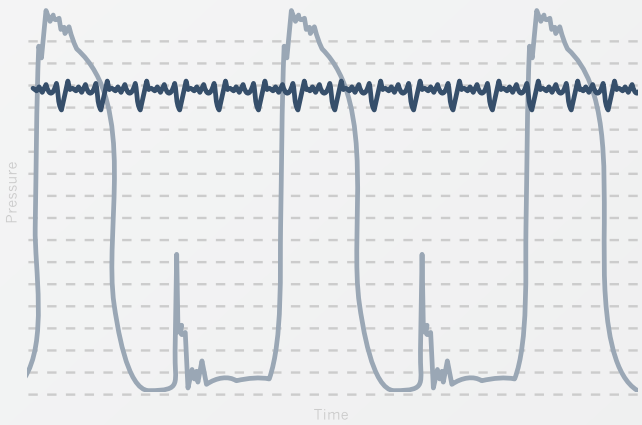




The virtually pulse-less flow from Hydra-Cell's multiple diaphragm single pump head gives a more even distribution of injected chemicals assisting in a complete chemical reaction, reducing cost by the efficient use of chemicals.

Pulsation Graph Comparison Operating without pulsation dampeners

Flow rate 689 lph / Pressure 6.9 bar



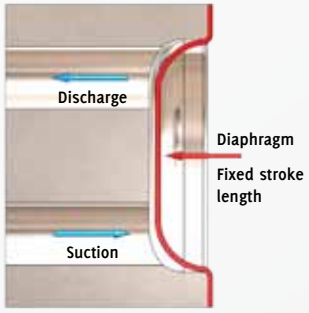
Hydra-Cell® pumps

Leading brand metering pump

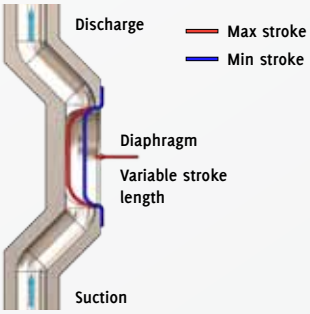
Accurate flow over a large turndown ratio

Achieved by controlling flow rate by pump RPM instead of stroke length adjustment. Every liquid has some compressibility. With Hydra-Cell, the compression ratio ensures a constant volumetric efficiency thus ensuring constant accuracy over a large turn down ratio.

Hydra-Cell metering pump
Constant compression ratio



Traditional metering pump
Varying compression ratio



Hydra-Cell patented hydraulic management system

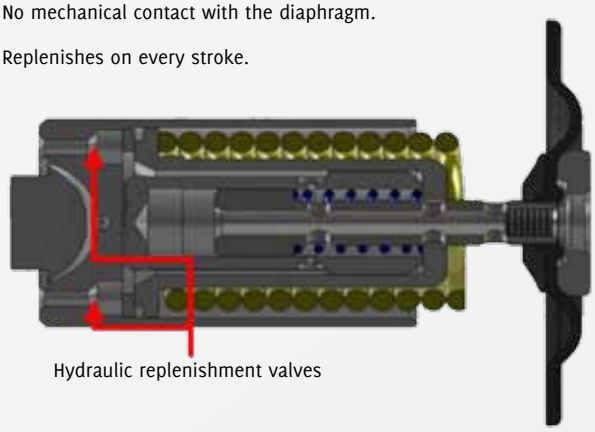
The accuracy of a metering pump with a hydraulically balanced diaphragm is significantly affected by controlling the volume of hydraulic oil behind the diaphragm and how the pump replenishes this actuating liquid.

With the Hydra-Cell P and G series, on every suction stoke if the correct amount of hydraulic oil is not present the vales open and the hydraulic cell is replenished. Ensuring a consistent diaphragm displacement and consistent and accurate flow rate on every stroke.

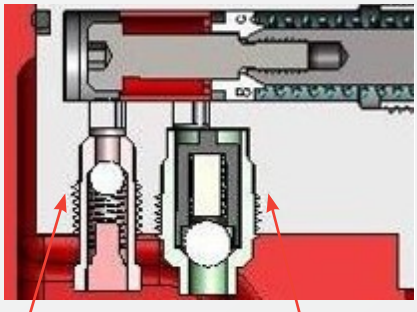
For the MT8 and T & Q series pumps, these utilise a patented hydraulic system consisting of an under fill and over fill value which compensates for any decrease in any actuating liquid on every stroke ensuring optimum accuracy.

Hydra-Cell technology

- No mechanical contact with the diaphragm.
- Replenishes on every stroke.



Hydraulic replenishment valves



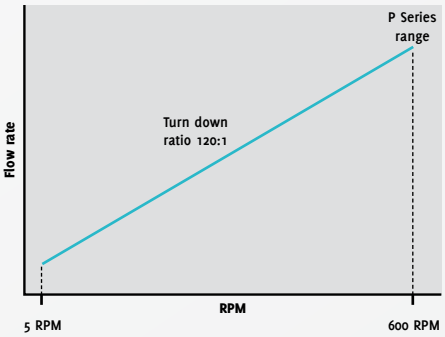
Over fill valve Under fill valve

Maintaining accuracy over a wide flow range giving ultimate flexibility

Because of Hydra-Cell's large turndown ratio and constant compression ratio, the same pump can be used in many different processes, making a very cost-effective and flexible metering pump.

P-Series pump range

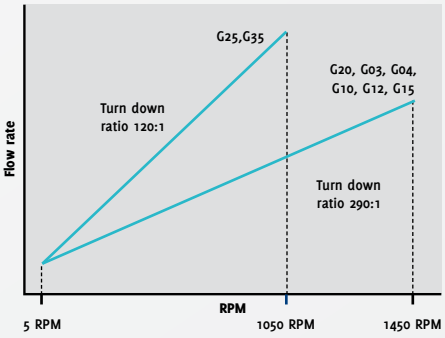
Wide adjustable flow range turn down ration of 120:1



P-Series pump range exceeds API675 performance criteria for Repeatability, Linearity and Steady state accuracy for the ultimate metering and dosing performance.

G-Series pump range

Wide adjustable flow range turn down ration of 290:1



G-Series pump range meets API675 performance criteria for Repeatability, Linearity and Steady state accuracy for the metering and dosing performance.

1 High pressure pipe flushing with 110°c water to remove sulphur build-up
2 Deionised water injection, Japan
3 Feeding hydrogenation reactor, Brazil

Hydra-Cell® ADVANTAGES AND FEATURES

Metering and Dosing | Process Pressure Injection | Transfer | Spray Drying | Cleaning

Reducing energy costs and meeting legislative efficiency targets

The energy efficiency of different pump technologies can vary significantly. Large energy savings can often be made by changing to another pumping principle.

Accurate control of the pump is also important to minimise energy consumption.

High efficiency for lower costs

- Hydra-Cell pumps operate at high efficiency levels. A move to a Hydra-Cell high-efficiency pump could provide a far greater benefit than a motor upgrade from IE2 to IE3 that only realises a few percentage points efficiency improvement.
- Hydra-Cell has a reciprocating positive displacement pumping action with multiple pumping elements to further enhance the overall efficiency. They are generally smaller than the competitor pumps and require smaller motors that are less expensive to acquire and more economical to operate.

Constant high efficiency over time

- The seal-less pumping chamber of the Hydra-Cell does not reply on the pumped liquid properties to maintain a pressure seal, this results in constant efficiency and reliability.
- From pump shaft to hydraulic power, Hydra-Cell's packing free design ensures constant high efficiencies through the life of the pump.

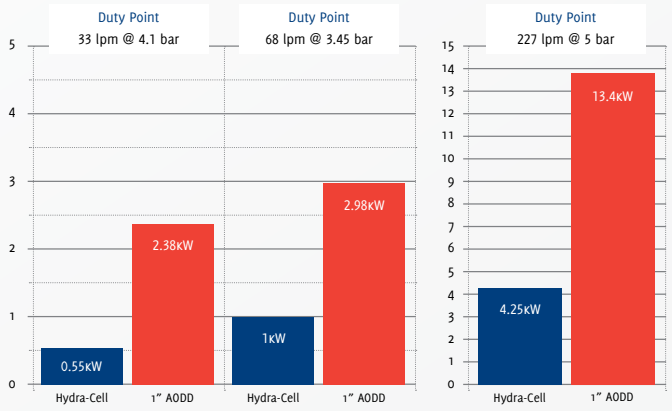
Energy saving features

- The flow rate of a Hydra-Cell pump is directionally proportionate to the input shaft speed and is easily controlled with a variable speed drive (VSD), a concept advocated within the Climate Change Agreement scheme for improved energy efficiency. The flow rate from the Hydra-Cell pump can be controlled accurately delivering only what is required and not wasting energy.
- Hydra-Cell technology can be controlled accurately even with open loop control, meaning that duties which require a fixed operating pressure under varying flow rate demand can be set up easily without bypassing liquid flow and wasting energy from approximately 5 RPM to maximum 1500 RPM.

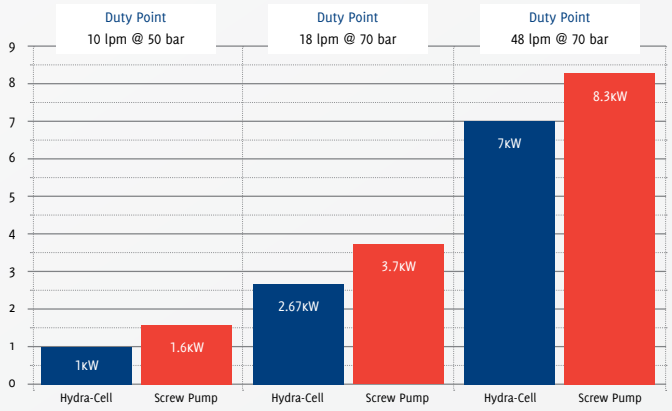
T & Q series pump range up to 600 lpm and 345 bar with efficiencies of over 90%

Comparing Hydra-Cell's energy requirements to those of other pump technologies

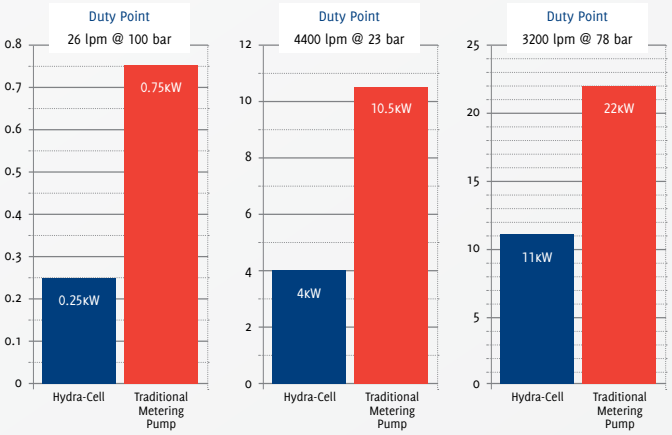
AODD Pumps



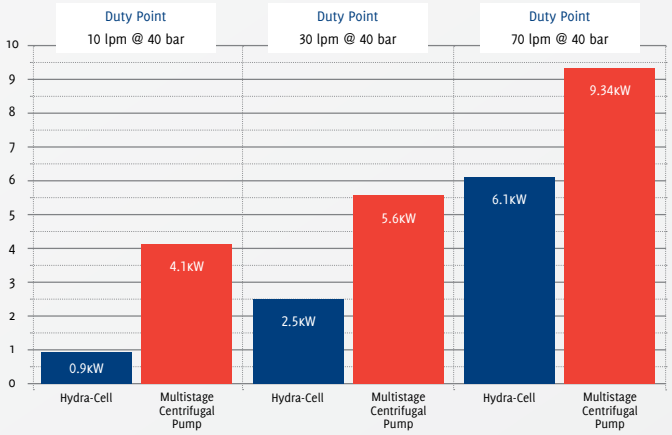
Screw Pumps



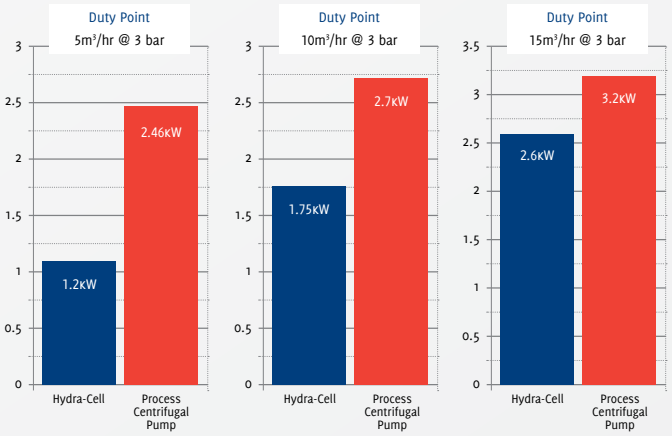
Traditional Metering Pumps



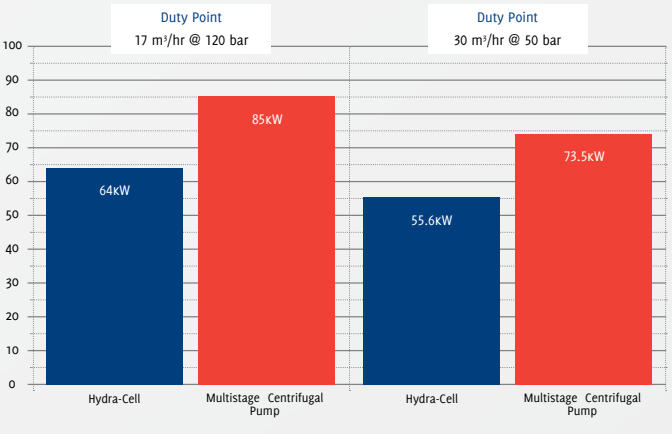
Vertical Multistage Centrifugal Pumps



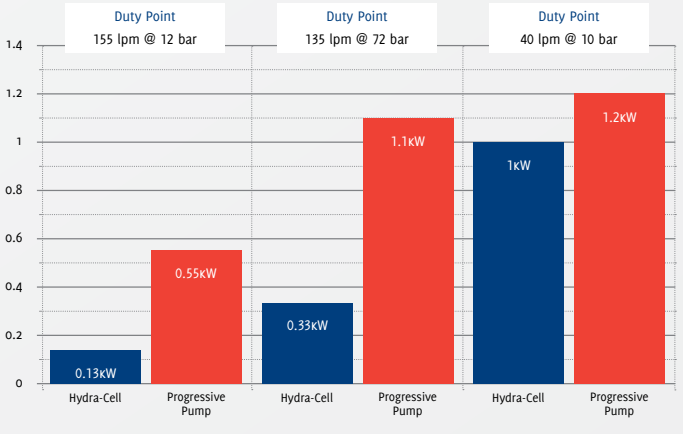
Chemical Process Centrifugal Pumps



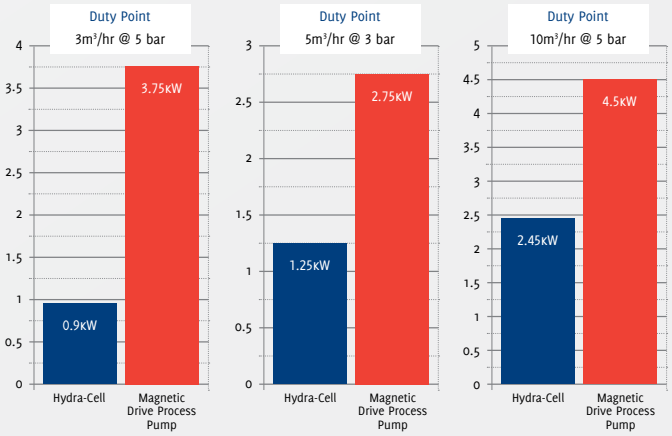
Horizontal Split Case Multistage Centrifugal Pumps



Progressive Cavity Pumps



Magnetic Drive Process Centrifugal Pumps



Hydra-Cell® ADVANTAGES AND FEATURES

Metering and Dosing | Process Pressure Injection | Spray Drying

Eliminate pump clogging & the need for regular clean-down to maintain operation

Fine suspended solids in liquids can be present due to many reasons:

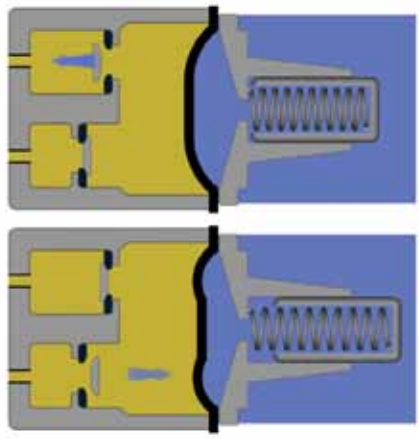
- By design.
- By moisture or air reacting with the chemical to form micro size crystals.
- By dissolved compounds coming out of solution due to temperature or pressure changes in the liquid forming micron size solid particles.
- By the liquid picking up small particles from corroded pipelines.

No blocking or deterioration of pump performance with Hydra-Cell

Hydra-Cell's seal-less design prevents air ingress from the atmosphere that can cause crystallisation in some process liquids, which can cause blocking and pumping performance deterioration.

- Air contact crystallisation that can cause seal wear in other pumps is eliminated thanks to Hydra-Cell's seal-less design.
- No requirement for seal maintenance means more productive time and greater efficiency.

Hydra-Cell with No Dynamic Seals



Hydra-Cell pumps handle liquids with suspended solids without clogging

- No tight internal tolerances that could become detrimentally affected by solids build-up.
- No 'dead' spaces in the pump chamber to encourage solids to drop out of suspension and collect within the pump causing eventual concretion and clogging.
- Hydra-Cell's spring loaded check valves:
  - Allow particles to flush through giving more reliable performance when pumping liquids with solid suspensions. Liquids with suspended granular solids in the range 30% can be pumped. (Up to 45% with special consideration to system design.)
  - They also allow viscous liquids up to 20,000 cps to be pumped.

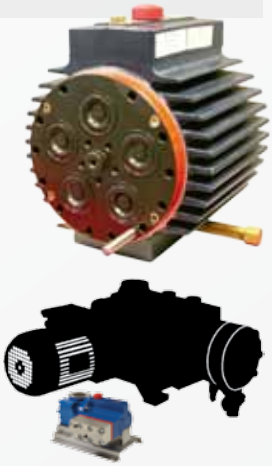
- Filtration can be designed for the process and not the pump.
- Filter maintenance is reduced or removed.

Lower the cost of acquisition, installation and maintenance

The efficiency of the pumping principle reduces the overall size of the pump for a specific flow rate and pressure.

Cost-saving design

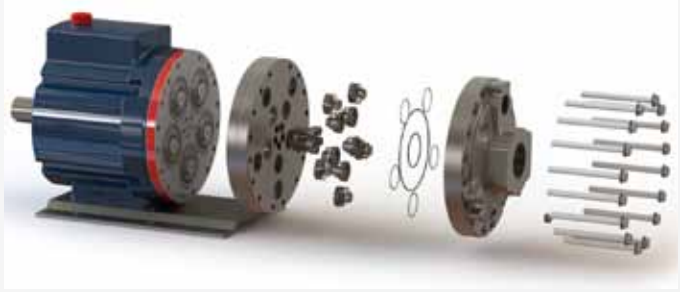
- Compared to other pumps with broadly comparable flows and pressures, Hydra-Cell pumps are less expensive to acquire, install and maintain due to its' positive displacement multi-pumping element design.
- Hydra-Cell pumps are more compact with a smaller footprint and are generally a fraction of the size of competitor pumps. This reflects in lower costs, especially where exotic alloys are required for wetted parts in order to pump aggressive chemicals.



Hydra-Cell (30kgs) is compact compared to traditional metering pumps (100kgs)

Flexible and modular

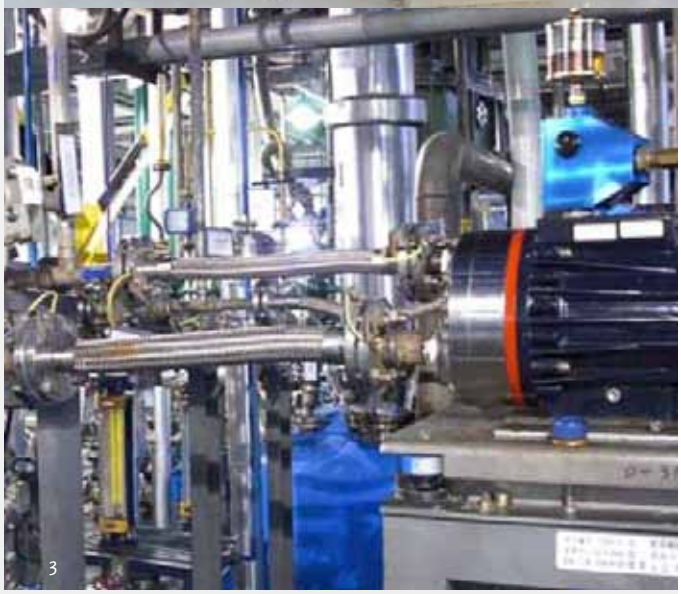
- A wide choice of materials of construction is available to match specifically the liquid being pumped. This can reduce acquisition, maintenance and servicing costs significantly. Selecting the best cost option material for the duty.
- Modular design, combined with the Hydra-Cell simple operating principle, ensures a pump properly configured for your process application, at a competitive price, tested and delivered with minimal lead-time.



Easier installation

The servicing requirements for Hydra-Cell pumps are possibly the lowest in the industry and probably the easiest to carry out. In many applications the pumps may be considered as 'maintenance free', other than for infrequent oil changes.

- The small footprint and compact size frees up valuable real estate and makes handling and installation easier.
- Servicing requirements are minimal and made easy by the ready availability of service kits.
- The seal-less design eliminates seal and packing maintenance that can represent up to 80% of maintenance costs for pumps with dynamic seals.
- All Hydra-Cell pumps are designed to be serviced on site without the need for special tools.



1 Metering Bio-diesel additive, Czech
2 Ammonia injection for NOx Emissions control, US Power Plant
3 Injection of proprietary monomers and inhibitors, China

Hydra-Cell® ADVANTAGES AND FEATURES

Metering and Dosing | Process Pressure Injection | Transfer | Spray Drying | Cleaning

No more breaking pipes & leaking chemicals

Leaking chemicals result in additional costs to the process:

- Wasted chemicals.
- Environmental clean-up.
- Health and safety for personnel.

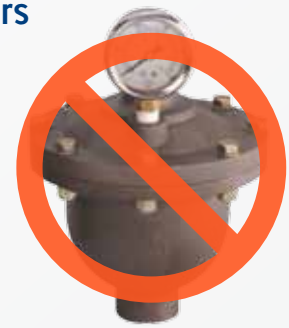
There are two main areas where leaking chemicals occur:

- Dynamic seals and packing.
- Damaged pipe joints due to hydraulic vibration.

No pulsation dampeners

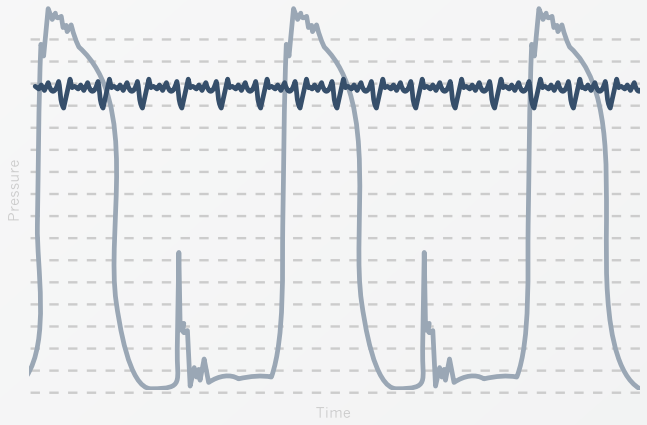
Hydra-Cell seal-less pumps provide a virtually pulse-less flow that dramatically reduces system vibration, pipe strain and fracture so minimising the incidence of chemical leaks.

- No need for expensive pulsation dampeners and their associated maintenance, for most applications.



Pulsation Graph Comparison
Operating without pulsation dampeners

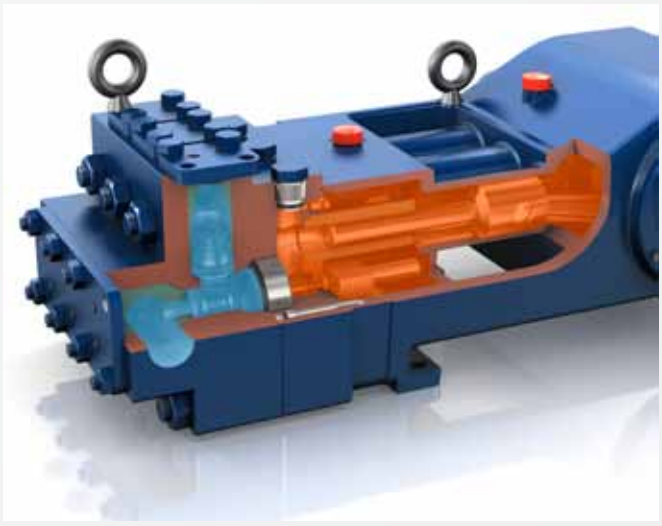
Flow rate 689 lph / Pressure 6.9 bar



No seals
No seal maintenance costs
100% containment

The seal-less design of Hydra-Cell pumps keeps the process liquid 100% contained, preventing chemicals and emissions leakage and removing environmental and safety concerns.

- Eliminates seal maintenance costs (In pumps with dynamic seals, 80% of maintenance and repair costs can be tribute to those seals.)
- Enables abrasive, non-lubricating and aggressive liquids to be pumped safely and successfully.
- No need for costly fine filtration.
- Removes the need for seal flushing.



No dynamic seals or packing in contact with the process liquid

Hydra-Cell®

ADVANTAGES AND FEATURES

Transfer | Spray Drying | Cleaning

Eliminate seal-flushing problems

Flushing of mechanical seals on industrial pumps is often undertaken to extend the life of the seal, especially where the pumped liquid is hot, or contains suspended solids, or abrasive particles that cause premature seal wear.

Many chemicals often form micron-sized solid crystals when subjected to temperature and humidity changes. Pumps with dynamic seals often need seal flushing to cope with this.

Liquid pumped into the seal from the output or from an external source cleans and cools the seal. A flushing system can be complex and costly to install and may involve feed pumps, heat exchangers, filters, pressure gauges, all of which add to the cost of the operation and the on-going maintenance requirement.

Reduced maintenance and reliable handling

Hydra-Cell seal-less pumps have no dynamic seals, packing or cups in contact with the pumped liquid and therefore require no seal flushing, saving on overall maintenance costs.

- Hydra-Cell pumps can handle liquids with up to 30% suspended granular solids.
- Abrasive particles in the range 1 to 20 microns, that are responsible for causing catastrophic damage to seals, pose no problems to Hydra-Cell pumps.
- Hydra-Cell pumps can handle hot liquids up to 120°C and have no tight internal tolerances and no seals to flush cool.

1 Pressure injecting liquid containing 30% non-dissolved titanium dioxide in deionised water, Germany
2 Polymer dosing for water treatment, USA
3 Nano filtration process for food additive manufacturer, Germany
4 Polystyrol transfer, Germany

Hydra-Cell® PERFORMANCE ADVANTAGES

Compared to Traditional Metering Pumps

- 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.
- Hydra-Cell's multiple-diaphragm design provides virtually pulse-free flow, eliminating the need for expensive pulsation dampeners in most instances.
- Hydra-Cell's diaphragms are available in a wide range of long life elastomeric materials unlike the solid PTFE diaphragms of traditional metering pumps, which can need regular and frequent replacement.
- Hydra-Cell pumps meet the same flow and pressure requirements as traditional metering pumps with a much smaller footprint, saving space and costs.
- Hydra-Cell pumps operate over a wide range of pressures without changes to the plunger or liquid end size whereas traditional metering pumps generally need different plunger and liquid end sizes.
- By using a separate gearbox as opposed to internal gearing, Hydra-Cell pumps avoid potential cross contamination of the actuating oil while simplifying maintenance procedures and reducing parts costs. Integral gearing in traditional metering pumps is difficult and expensive to maintain.

Compared to Progressing Cavity Pumps

- Unlike progressing cavity pumps, Hydra-Cell pumps have no dynamic seals to become worn by abrasive particles.
- Hydra-Cell pumps can also run dry without damage whereas progressing cavity pumps must not run dry as the heat generated by the rotor and stator can cause complete failure.
- Having no internal leak paths, Hydra-Cell pumps maintain flow rate regardless of pressure whereas the hydrodynamic seal between rotor and stator in a progressing cavity pump can break down under pressure reducing accuracy and repeatability.

Compared to Gear Pumps

- The seal-less design of Hydra-Cell means that, unlike gear pumps, there are no seals or packing to leak or replace.
- No bearings or bushes run in the pumped liquid, so Hydra-Cell can handle the thin, abrasive and non-lubricating liquids that can destroy gear pumps.
- With no internal gears to wear, Hydra-Cell maintains accuracy and efficiency with less maintenance and lower replacement parts requirement.
- Hydra-Cell pumps have a higher volumetric efficiency, virtually irrespective of pressure whereas gear pumps have internal leak paths (fixed clearances) that reduce efficiency as pressures increase.
- Hydra-Cell's hydraulically balanced design means, unlike gear pumps, there are no overhung loads on the shaft bearing.

Compared to Plunger Pumps

- Fine abrasive particles and hot liquids both damage plunger pump seals. Having no dynamic seals, Hydra-Cell pumps handle abrasive particles without fine filtration and can pump hot liquids with ease.
- Hydra-Cell pumps can run dry indefinitely without damage, a condition that would destroy a plunger pump.
- In a Hydra-Cell pump, the crank oil and process liquid are completely separated enabling long oil change intervals. Plunger pump seals are designed to leak and in many instances this process liquid contaminates the crank oil resulting in the need for frequent replacement.

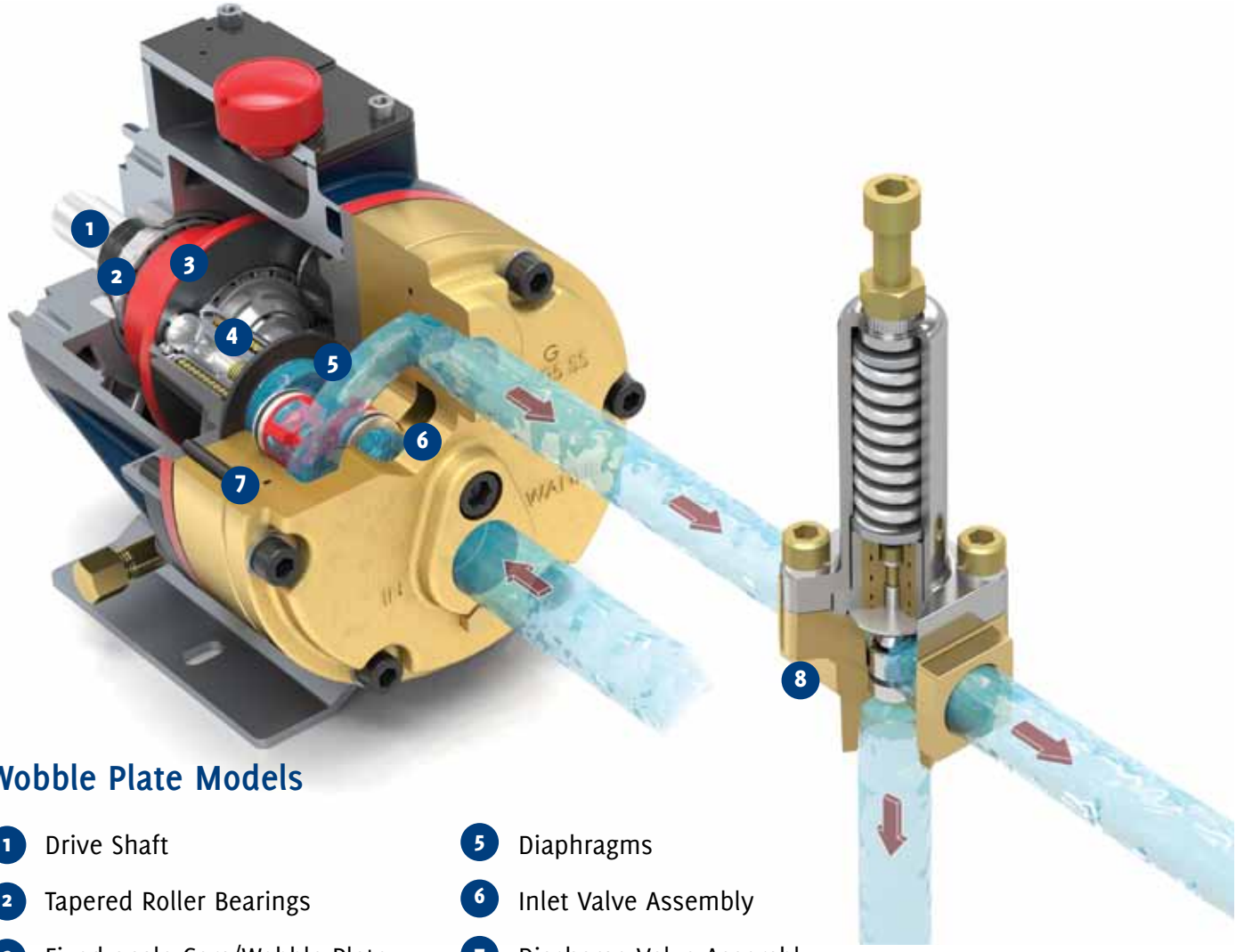
Compared to Magnetic Drive Pumps

- Hydra-Cell pumps can run dry indefinitely without damage, a condition that would destroy a magnetic drive pump.
- The seal-less pumping chamber and spring loaded check valves of a Hydra-Cell pump are designed to handle particulates and abrasives whereas magnetic drive pumps will only handle clean, liquids successfully.
- Hydra-Cell's low shear pumping action handles higher viscosity liquids, unlike magnetic drive units that are designed to pump lower viscosities only.
- Hydra-Cell pumps are more efficient than magnetic drive pumps, which have higher power requirements and higher energy costs.
- Hydra-Cell pumps have a smaller footprint than most comparable magnetic drove pumps. They consume less power, are easier to service and have lower acquisition, and operating costs.

Compared to Peristaltic Pumps

- Hydra-Cell multi-diaphragm pumps have a smoother flow than peristaltic pumps, which pulse on discharge and often require expensive pulsation dampeners.
- Peristaltic pump tubes operate under stress and are consumable wear parts whereas Hydra-Cell's balanced diaphragms operate under no stress leading to a long life.

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.

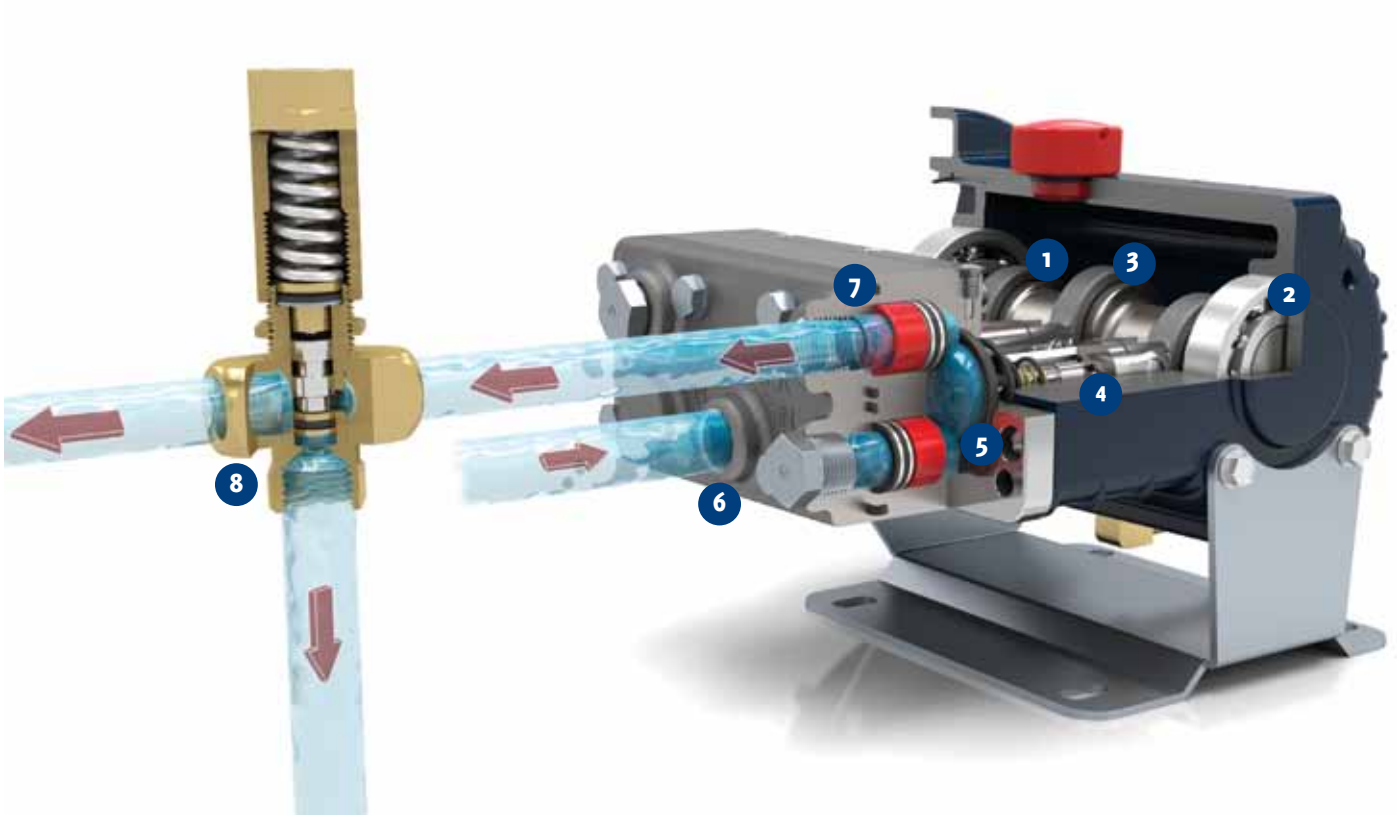
The oil held in the Hydra-Cell balances the back side of the diaphragms (5) and causes the diaphragms to flex forward and back as the Wobble plate moves. This provides the pumping action.

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.

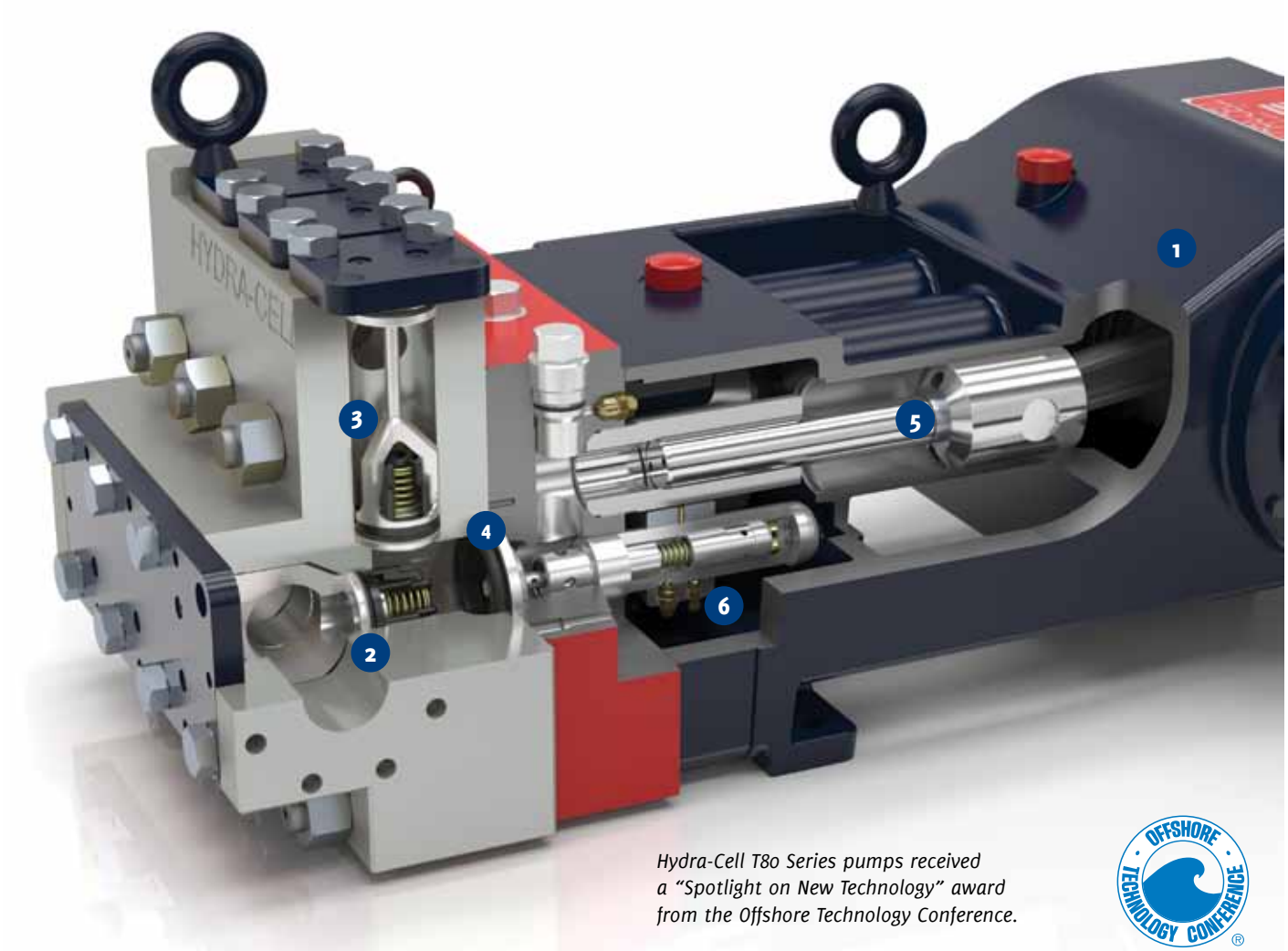
Hydra-Cell crank-shaft pumps can have up to three diaphragms, and each diaphragm has its own pumping chamber that contains an inlet and discharge self-aligning horizontal disk check valve assembly (6). As the diaphragms move back, liquid enters the pump through a common inlet and passes through one of 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 - Asynchronous Design

API 674 option available

Exclusive Seal-less Diaphragm Design



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

Asynchronous Models

1. Drive Shaft
2. Inlet valve assembly
3. Discharge valve assembly
4. Diaphragms
5. Plunger
6. Underfill and overfill valves

Reliable, Efficient Pumping Action

The seal-less design of Hydra-Cell High Horsepower pumps eliminates leaks, hazards and the expense associated with seals and packing. The diaphragms completely separate the process liquid from the pump drive with no dynamic seals or packing being exposed to the pumped liquid.

The pump's high efficiency results in lower energy costs than centrifugal pumps and other pump technologies, while the simple, asynchronous design and exceptionally rugged construction lead to very low maintenance and service requirements. The hydraulically balanced diaphragms are able to handle high pressures with low stress.

These pumps can operate with a closed or blocked suction line and can run dry indefinitely without damage, eliminating downtime and repair costs. Their low NPSH requirements allow for operation with a vacuum condition on the suction… positive suction pressure is not necessary.

Thanks to unique diaphragm and valve designs, these pumps are able to handle more abrasives with less wear than gear, screw or plunger pumps. Their compact design and double-ended shaft provide a variety of installation options.

Hydra-Cell High Horsepower pumps can be configured to meet API 674 standards – consult factory for details.

Hydra-Cell® MATERIALS OF CONSTRUCTION

With over 40 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.

Manifolds

Manifolds for Hydra-Cell pumps are available in a variety of materials to suit your process application. They are easy to replace and interchangeable to accommodate different liquids processed by the same pump. Special manifolds with a 2:1 dosing ratio are also available. (Consult factory.)

Non-metallic Pump Heads

Non-metallic pump heads are often used when a corrosive or aggressive liquid is being processed at lower pressures.

- Polypropylene
- PVDF

Metallic Pump Heads

Metallic pump heads can handle higher operating pressures. Hastelloy CW12MW or Stainless Steel is also selected for corrosion resistance and other properties.

- Brass
- Bronze
- Cast Iron (Nickel-plated)
- Duplex Alloy 2205
- Super Duplex Alloy 2507
- Hastelloy CW12MW
- 304 Stainless Steel
- 316L Stainless Steel

Diaphragms and O-rings

Diaphragms and corresponding o-rings are available in several elastomeric materials.

- Aflas (used with PTFE O-ring)
- Butyl
- Buna-N
- EPDM (requires EPDM-compatible oil)
- FFKM
- FKM
- Neoprene
- PTFE

Valve Materials

Hydra-Cell valve assemblies (seats, valves, springs, and retainers) are available in a variety of materials to suit your process application.

Valve Seats

- Ceramic
- Hastelloy CW12MW
- Nitronic 50
- Tungsten Carbide
- 17-4 PH Stainless Steel
- 316L Stainless Steel

Valves

- Ceramic
- Hastelloy CW12MW
- Nitronic 50
- Tungsten Carbide
- 17-4 PH Stainless Steel

Valve Springs

- Elgiloy (Exceeds SST grade 316L)
- Hastelloy CW12MW
- 17-7 PH Stainless Steel
- 316L Stainless Steel

Valve Spring Retainers

- Celcon
- Hastelloy CW12MW
- Nylon (Zytel)
- Polypropylene
- PVDF
- 17-7 PH Stainless Steel

Registered trademarks of materials:

Aflas®	Asahi Glass Co., Ltd.
Buna®-N (Nitrile)	E.I. Du Pont de Nemours and Company, Inc.
Celcon®	Celanese Company
Elgiloy®	Elgiloy Limited Partnership
Hastelloy® CW12MW	Haynes International, Inc.
Kynar® (PVDF)	Arkema, Inc.
Mesamoll®	Lanxess Deutschland GmbH
Neoprene®	E.I. Du Pont de Nemours and Company, Inc.
Nitronic® 50	AK Steel Corporation
Teflon® (PTFE)	E.I. Du Pont de Nemours and Company, Inc.
Viton® (FKM)	DuPont Performance Elastomers, LLC
Zytel® (Nylon)	E.I. Du Pont de Nemours and Company, Inc.

Hydra-Cell G Series Seal-less Pumps

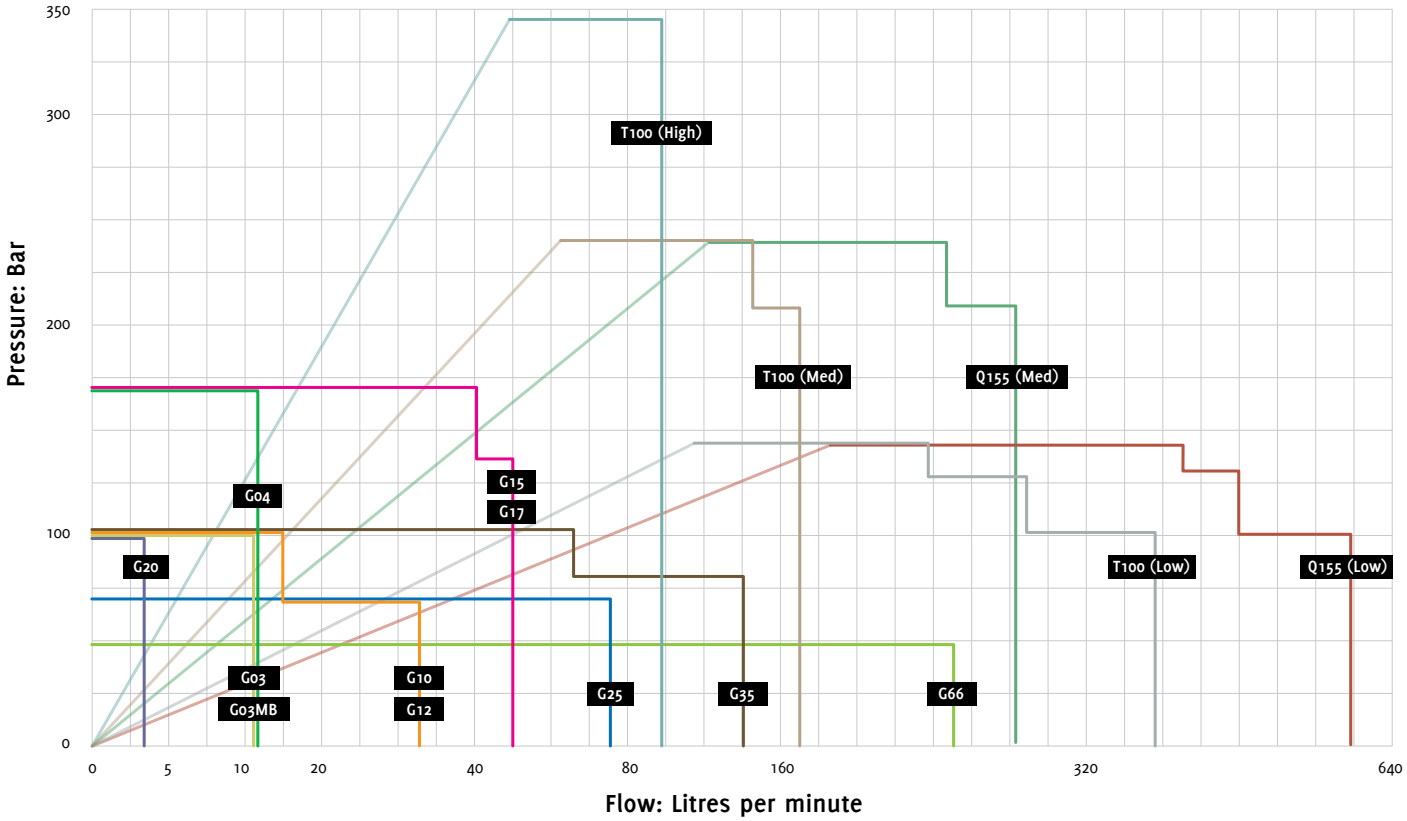
Hydra-Cell T Series Seal-less Pumps

Hydra-Cell Q Series Seal-less Pumps

Hydra-Cell Seal-less Metering Solutions Pumps

Hydra-Cell® Flow Capacities and Pressure Ratings

G, T and Q 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.

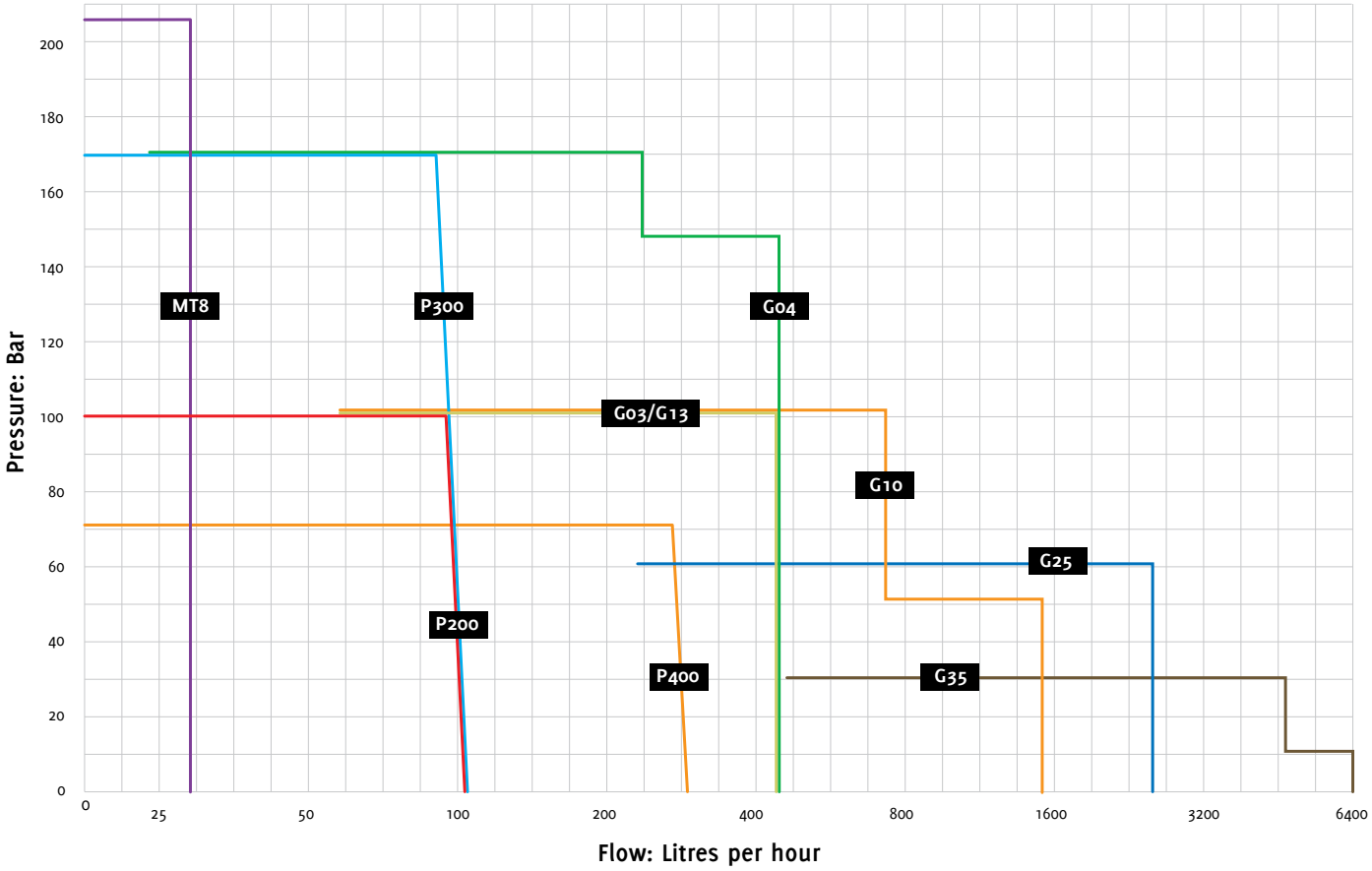
Model	Maximum Capacity l/min	Maximum Discharge Pressure bar		Maximum Operating Temperature °C[2]		Maximum Inlet Pressure bar
		Non-Metallic[1]	Metallic	Non-Metallic	Metallic	
G20	3.8	24	103	60°	121°	17
G03	11.7	24	103	60°	121°	17
G04	11.2	N/A	200	N/A	121°	34
G10	33.4	24	103	60°	121°	17
G12	33.4	N/A	103	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
G66	248	17	48	49°	121°	17
T100S	98	N/A	345	N/A	82°	34
T100M	144	N/A	241	N/A	82°	34
T100K	170	N/A	207	N/A	82°	34
T100H	259	N/A	145	N/A	82°	34
T100F	290	N/A	128	N/A	82°	34
T100E	366	N/A	103	N/A	82°	34
Q155E	595	N/A	103	N/A	82°	34
Q155F	490	N/A	127	N/A	82°	34
Q155H	421	N/A	144	N/A	82°	34
Q155K	295	N/A	207	N/A	82°	34
Q155M	253	N/A	241	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® Metering & Dosing Pumps – ATEX / Explosive Areas

Flow Capacities and Pressure Ratings

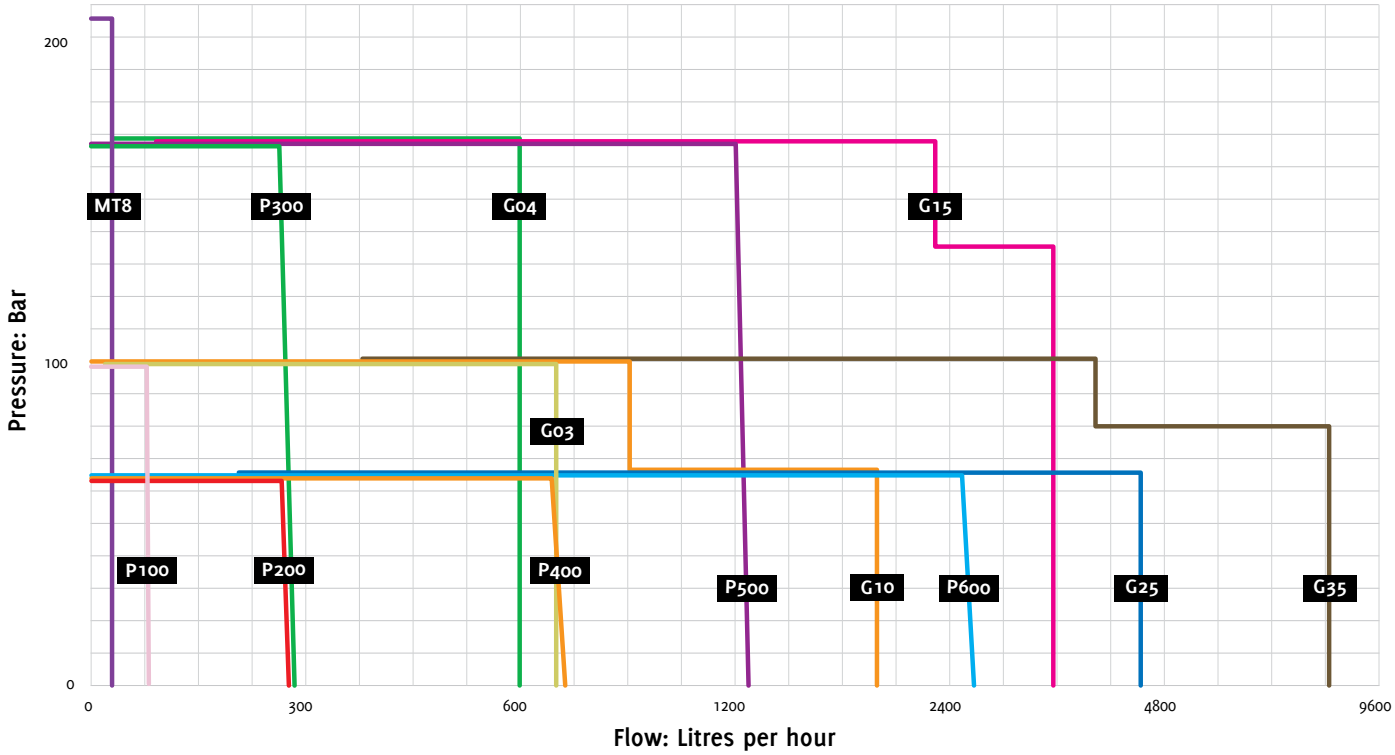


Model	Maximum Capacity l/hr	Maximum Discharge Pressure bar		Maximum Operating Temperature °C[2]		Maximum Inlet Pressure bar
		Non-Metallic[1]	Metallic	Non-Metallic	Metallic	
MT8	30	N/A	241	N/A	121°	17
P200	102	24	103	60°	121°	17
P300	95	N/A	172	N/A	121°	34
P400	305	24	69	60°	121°	17
G13 - M2H	462	24	103	60°	121°	17
G13 - M2M	462	24	60	60°	121°	17
G13 - M4L	230	24	20	60°	121°	17
G13 - M2L	462	24	20	60°	121°	17
G04 - M4H	226	N/A	172	N/A	121°	34
G04 - M2M	452	N/A	150	N/A	121°	34
G10 - M4H	732	24	103	60°	121°	17
G10 - M2M	1470	24	50	60°	121°	17
G10 - M4L	732	20	20	60°	121°	17
G10 - M2L	1470	20	20	60°	121°	17
G25 - M4L	2600	20	20	60°	121°	17
G25 - M4M	2600	24	60	60°	121°	17
G35 - M2L	6360	N/A	10	N/A	121°	10
G35 - M4L	4800	N/A	30	N/A	121°	17

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® Metering & Dosing Pumps – Electronic Control

Flow Capacities and Pressure Ratings



Model	Maximum Capacity l/hr	Maximum Discharge Pressure bar		Maximum Operating Temperature °C[2]		Maximum Inlet Pressure bar
		Non-Metallic[1]	Metallic	Non-Metallic	Metallic	
MT8	30	N/A	241	N/A	121°	17
P100	85	24	103	60°	121°	17
P200	255	24	103	60°	121°	17
P300	257	N/A	172	N/A	121°	34
P400	766	24	69	60°	121°	17
P500	1244	N/A	172	N/A	121°	34
P600	2808	24	69	60°	121°	17
G03	660	24	103	60°	121°	17
G04	660	N/A	172	N/A	121°	34
G10	1800	24	69	60°	121°	17
G10	900	24	103	60°	121°	17
G15	2940	N/A	138	N/A	121°	34
G15	2280	N/A	172	N/A	121°	34
G25	4560	24	69	60°	121°	17
G35	8280	N/A	83	N/A	121°	34
G35	3960	N/A	103	N/A	121°	17

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® Metering and Dosing Control Options

For G Series, P-Series and MT8 pumps

Electronic Flow Rate Adjustment
For Local Control

- ATEX Dust Zone 21 (Ex tb III C T125c Db)
- IP66 Standard
- Various flow rate adjustments options including:
  - On-board potentiometer(s)
  - On-board key-pad controller with flow rate display
  - Removable, hand-held key-pad controller for authorised personnel only

On-board
keypad control

Hand-held
keypad control

Control Freak
For Sophisticated Local Control

- Option available to control up to 6 x Hydra-Cell pumps with one Hydra-Cell “Control Freak”
- Multiple Variable Frequency Dive (VFD) options
- Enables programming for flow rate or totalisation
- Allows up to 10 x separate batch sequences
- Built-in Calibration mode
- Wireless option available

Mechanical Flow Rate Adjustment
For Local Control

ATEX

- ATEX Zone 1
- Linear fine adjustment scale on hand-wheel
- High reliability due to frictionless design
- Option to fit a mechanical lock to prevent unauthorised flow rate change

Notes

WANNER

Hydra-Cell®

Partners in over 70 Countries

WANNER ENGINEERING - WORLD HEADQUARTERS & MANUFACTURING
Minneapolis USA
t: (612) 332-5681
e: sales@wannereng.com

WANNER ENGINEERING
Latin American Office
t: +55 (11) 3565 4001
e: sales@wannereng.com

WANNER PUMPS
Shanghai CHINA
t: +86-21-6876 3700
e: sales@wannerpumps.com

WANNER PUMPS
Kowloon HONG KONG
t: +852 3428 6534
e: sales@wannerpumps.com

WANNER INTERNATIONAL
Hampshire UK
t: +44 (0) 1252 816847
e: sales@wannerint.com

www.hydra-cell.eu

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