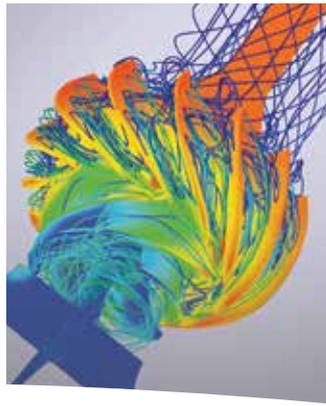




MP1
Multiphase Twin-Screw Pump



Experience In Motion



Pump Supplier to the World

Flowserve is the driving force in the global industrial pump marketplace. No other pump company in the world has the depth or breadth of expertise in the successful application of pre-engineered, engineered, and special purpose pumps and systems.

Life Cycle Cost Solutions

Flowserve provides pumping solutions that permit customers to reduce total life cycle costs and improve productivity, profitability and pumping system reliability.

Market-Focused Customer Support

Product and industry specialists develop effective proposals and solutions directed toward market and customer preferences. They offer technical advice and assistance throughout each stage of the product life cycle, beginning with the initial inquiry.

Broad Product Lines

Flowserve offers a wide range of complementary pump types, from pre-engineered process pumps to highly engineered and special purpose pumps and systems. Pumps are built to recognized global standards and customer specifications.

Pump designs include:

- Single-stage process
- Between bearings single-stage
- Between bearings multistage
- Vertical
- Submersible motor
- Positive displacement
- Nuclear
- Specialty

Product Brands of Distinction

ACEC™ Centrifugal Pumps

Aldrich™ Pumps

Byron Jackson® Pumps

Calder™ Energy Recovery Devices

Cameron™ Pumps

Durco® Process Pumps

Flowserve® Pumps

IDP® Pumps

Lawrence Pumps®

Niigata Worthington™ Pumps

Pacific® Pumps

Pleuger® Pumps

Scienco™ Pumps

Sier-Bath® Rotary Pumps

TKL™ Pumps

United Centrifugal® Pumps

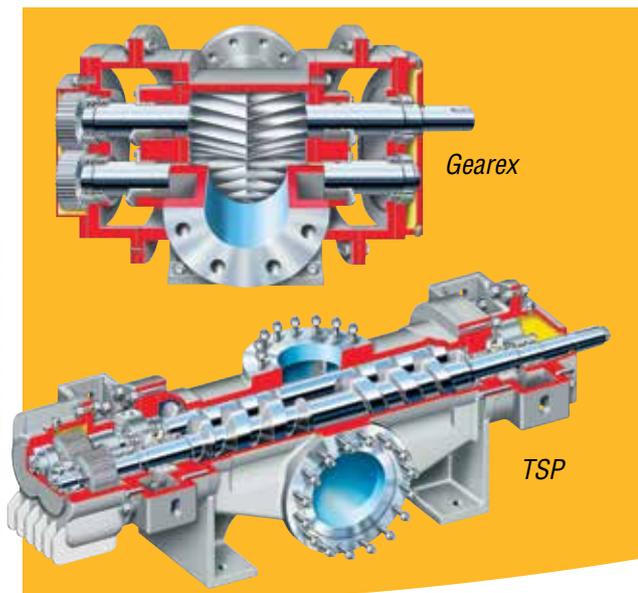
Western Land Roller™ Irrigation Pumps

Wilson-Snyder® Pumps

Worthington® Pumps

Worthington Simpson™ Pumps

MP1
Multiphase
Twin-Screw Pump



Engineered Rotary Pump Solutions

The Flowserve MP1 double-suction, twin-screw, positive displacement pump was specifically engineered to handle the most aggressive challenges of today's multiphase upstream oil field production while consistently providing high availability. The rugged and versatile MP1 readily accommodates rapid changes in oil well viscosities, water cuts, gas-to-liquid ratios and gas volume fractions (GVF), which vary over the life of the oil field. The pump's versatility, maintenance ease and reliability provide users with life cycle cost economies to optimize oil production.

Advantages Over Helico-Axial Rotodynamic Pumps

- Greater pressure boosts on high gas volume fractions
- Constant torque load on pump drive system
- Improved efficiency when pumping high viscosity products
- Positive displacement design eliminates gas vapor lock
- No flow conditioners required upstream of the pump
- Reduced wear due to lower speed operation
- Lower operating vibration and noise levels

Upstream Applications

- Surface pumping onshore and offshore
- Subsea ultra-deepwater pumping
- Wet gas compression
- Flare gas reinjection
- Pipeline boosting

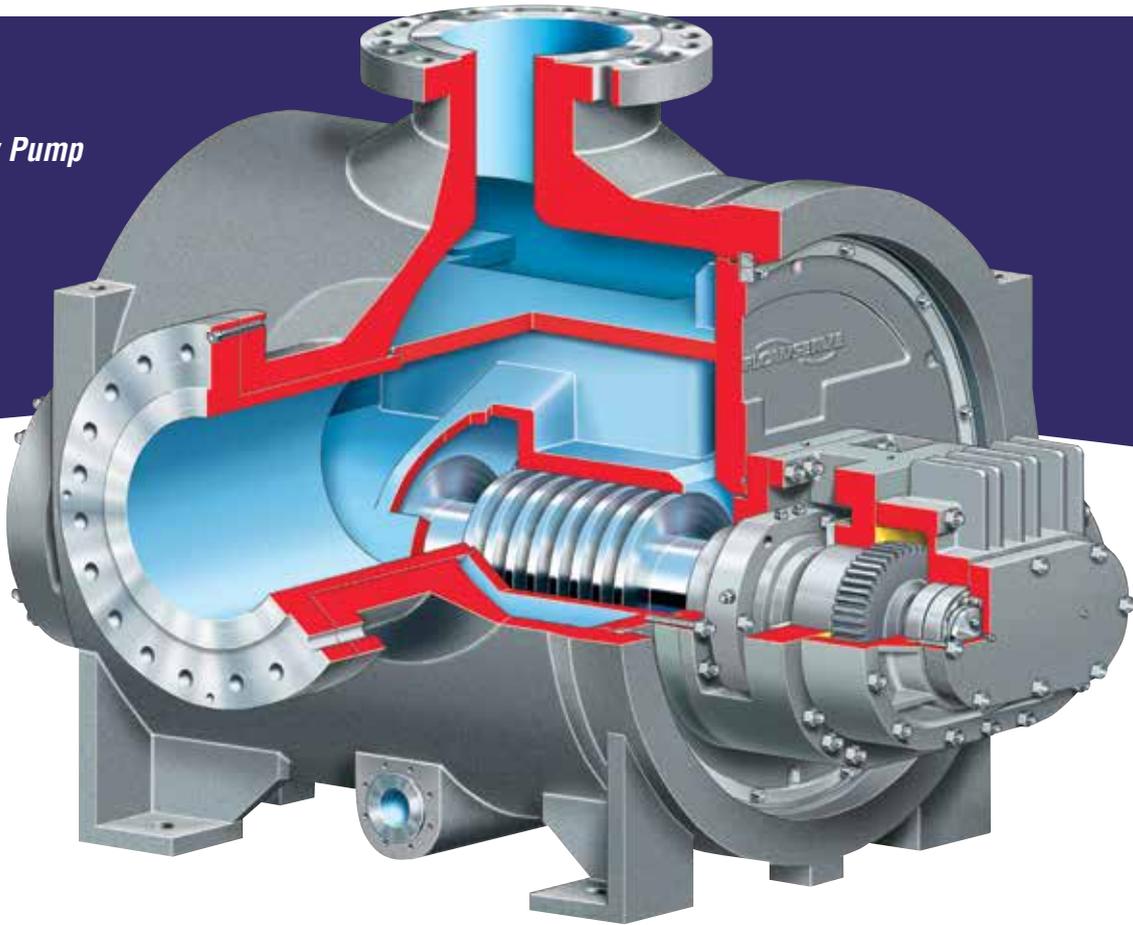
Benefits of the MP1

- Ease of Maintenance
 - Back pullout design of rotating assembly
 - Radially split bearing bracket construction
 - Cartridge type, single or dual mechanical seals
 - Tapered shaft mounting of coupling hub
 - No special tools required
- Versatility
 - High volumetric efficiency over a wide range of viscosities, gas-to-liquid ratios and GVF
 - Gas slug and run-dry capabilities
 - High temperature operation
 - Multiple seal options
- Heavy-Duty Reliability
 - Robust cast casing design with flanged nozzles
 - Custom screw profiling for low pressure pulsations
 - Oversized and rigid integral shaft design
 - Through-bolt bearing bracket construction
 - Heavy-duty bearings
 - Abrasion-resistant coatings
- Low Total Cost of Ownership
 - Individual serviceability of bearings and seals
 - Refurbishing program for shafts and casings
 - Replaceable rotating assembly
 - Replaceable inner casing

System Packaging

Flowserve engineers and technicians possess systems packaging expertise and can incorporate piping skids, variable frequency drives (VFD), control panels and power houses into multiphase pump systems.

MP1
Multiphase
Twin-Screw Pump



The Flowserve MP1 is the most robust twin-screw pump in the oil and gas industry. Engineered for multiphase pumping, it features a double-suction, timed twin-screw configuration built in accordance with API 676, latest edition. The design of the MP1 was further refined to provide the highest overall efficiency and lowest operating vibration levels of any multiphase, twin-screw pump.

For improved reliability and prolonged life, the MP1 design incorporates separate oil reservoirs for bearings and timing gears. This construction is well suited to pump raw effluent, consisting of varying volumes of oil, water and gas, as well as solids and asphaltenes, from upstream wells without pre-gas separation.

Operating Parameters

- Flows to 2258 m³/h (340 900 bpd)
- Pressure to 50 bar (720 psi); custom designs for higher pressures
- Temperatures to 450°C (842°F)
- Viscosities to 8000 cP
- Gas volume fractions from 0% to 100%

Features and Benefits

Double-suction Design provides balanced hydraulic loads by channeling incoming flow to the screw inlets at each end of the pump. It also ensures mechanical seals are exposed only to pump inlet pressure.

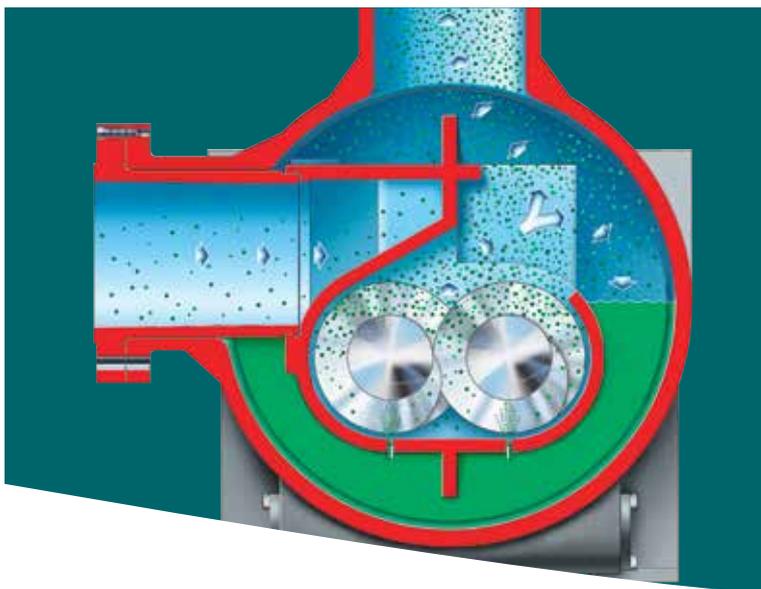
External Bearings and AGMA 11 Timing Gears are in separate oil reservoirs to eliminate exposure to the pumped fluid, providing an ideal lubrication environment.

Integral (One-piece) Non-contacting Shaft Design ensures the operating shaft deflection does not exceed the radial clearance between the shaft and inner casing.

Versatile ISO 21049/API 682 Seal Chamber readily accommodates multiple seal types and meets HSE regulations without modification.

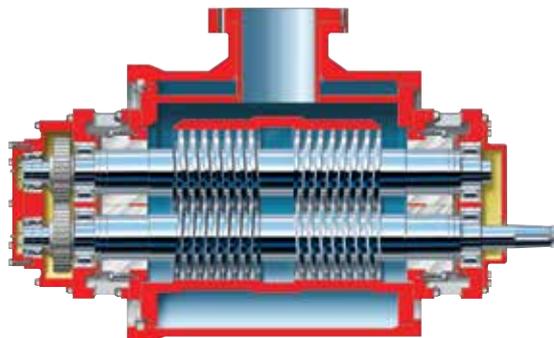
Split Bearing Bracket Construction facilitates maintenance of individual bearings and mechanical seals without disturbing components not in need of replacement.

Modular Non-welded Casing is available in multiple standard and specialty alloys. The integral design of the nozzles in the outer casing ensures that any pipe loads are not directly applied to the inner casing to maintain a non-contacting shaft design.



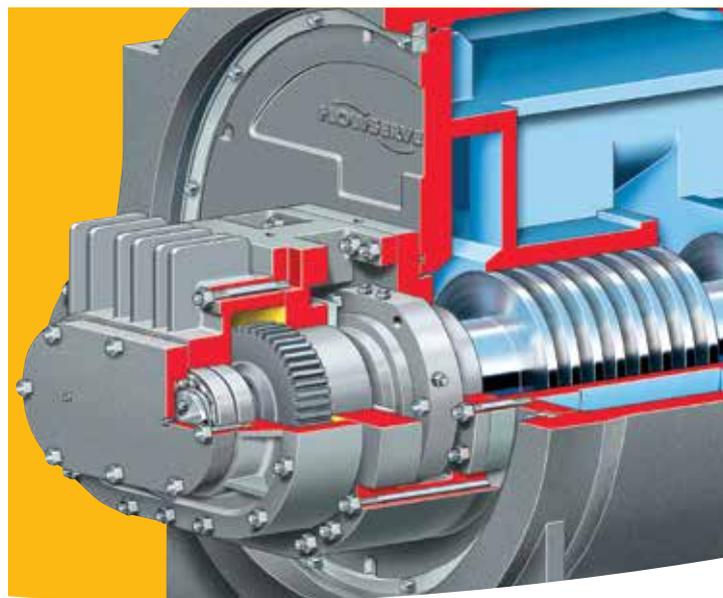
Large Volume Casing Trap for Liquid Re-Injection

A dynamic liquid seal is required between the intermeshing screws when pumping multiphase mixtures with high gas volume fractions or during gas slugs. As such, the MP1 incorporates a large chamber between the outer and inner casings which captures liquid and re-injects it into the screw inlets via internal ports using the pump discharge pressure. This simple, reliable approach ensures the dynamic seal is always maintained. It also dissipates the heat of compression associated with multiphase pumping.



Lowest Operating Vibration Levels

- Vibration levels meet API 676, latest edition.
- Full radial load is supported between bearings to ensure a non-contacting design.
- Integral screws cut 180° out of phase to reduce amplitude of pulsations
- Minimum of three pumping locks and special screw profiling to distribute pressure profile development
- Full perimeter through-bolt bearing bracket design
- Two-plane dynamic shaft balancing to ISO 1940 G2.5 level to minimize residual imbalance

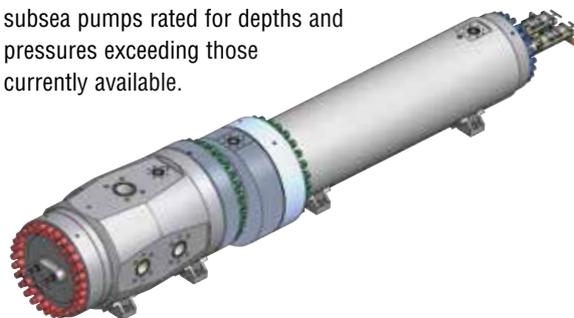


Split Bracket With Through-Bolt Design

A distinct maintenance feature of the MP1 is the split bearing bracket design, which offers full-perimeter through-bolt construction for maximum support and stiffness. The bearing housing portion of the bracket can be separately removed to permit servicing of the bearings without disturbing the mechanical seals. Since the parting flange of the bracket is near the casing, maximum access is provided to the mechanical seals, each of which can be removed and replaced without disturbing the other on the adjacent shaft. The critical positioning of the bearing bracket assembly is maintained using hardened dowel pins, so proper alignment is assured during reassembly.

Subsea Applications

Flowserve continues to develop new technologies to deploy multiphase twin-screw pumps deep into the ocean. The result is a turnkey solution that involves design, manufacturing, and installation of subsea pumps rated for depths and pressures exceeding those currently available.



**Options and
Technical Data**



Pre-Engineered Shaft Sealing Solutions

- Single cartridge mechanical seals with inboard restriction bushing supported by API Plan 32 flush plan. Ideal for services with low H₂S levels and an external flush source
- Single cartridge mechanical seals supported by a common lube oil system. Designed for remote, high GVF applications without an external flush source
- Double cartridge mechanical seals supported by either API Plan 53 or API Plan 54. Designed for applications with high HSE risks due to high H₂S levels or solids contents and where a reliable external flush source is not available

Hard, Abrasion-Resistant Coatings

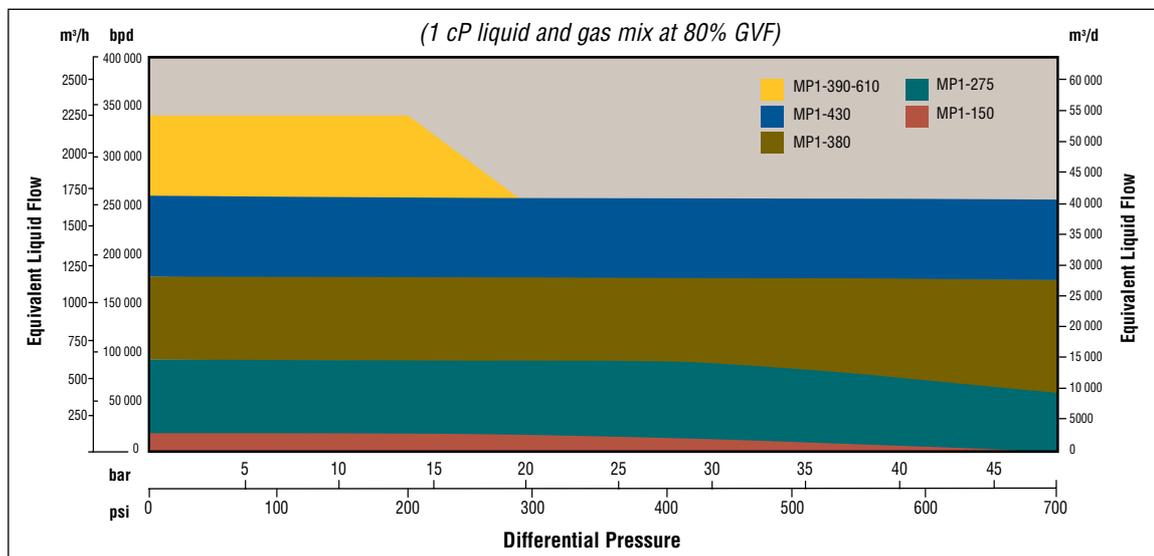
Hard coatings reduce corrosion and wear on critical parts. They also offer protection against galling during short-term upset conditions. The result is increased mean time between pump repair.

- Casing bores can be coated with overlays with a minimum hardness of 70 Rc.
- Screw outer diameters can be manufactured with abrasion-resistant coatings with a minimum hardness of 40 Rc.
- In-house testing lab to confirm pressure and velocity load handling characteristics of coatings

Materials of Construction

Component	Standard API Design	Upgraded API Design	Corrosion-Resistant API Design
Outer casing	Ductile iron or Cast steel	Cast steel	Ni-Resist or Cast stainless steel
Inner casing	Ductile iron	Cast steel	Ni-Resist or Cast stainless steel
Integral shafts	Carbon steel	Carbon steel or Stainless steel	Stainless steel
Seal plate half of bracket	Carbon steel plate		Stainless steel plate
Bearing housing half of bracket	Cast steel		
Front cover; Gear housing	Cast steel		
Rear caps	Carbon steel		
Timing gears	Case carburized carbon steel		

MP1 Range Chart



**Global Service
and Technical
Support**



Life Cycle Cost Solutions

Typically, 90% of the total life cycle cost (LCC) of a pumping system is accumulated after the equipment is purchased and installed. Flowserve has developed a comprehensive suite of solutions aimed at providing customers with unprecedented value and cost savings throughout the life span of the pumping system. These solutions account for every facet of life cycle cost, including:

Capital Expenses

- Initial purchase
- Installation

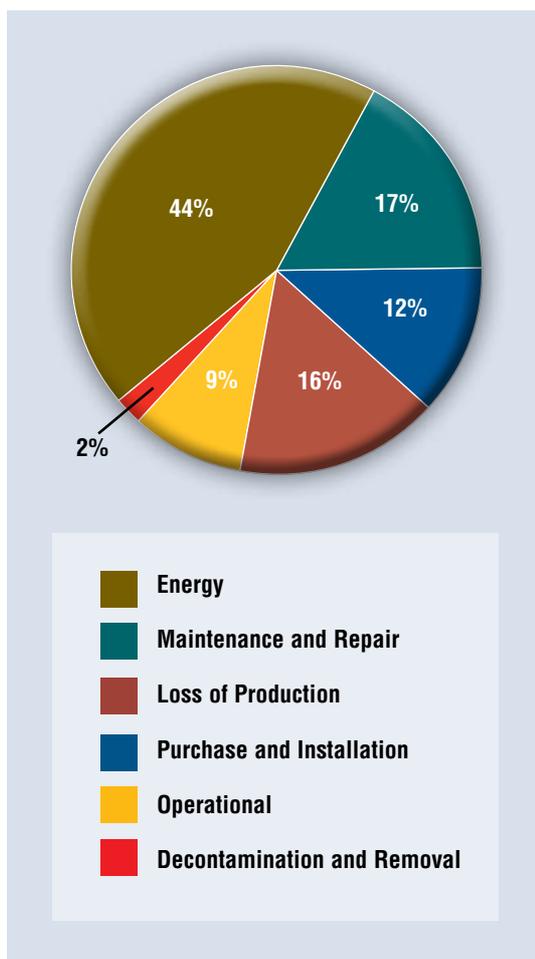
Operating Expenses

- Energy consumption
- Maintenance
- Production losses
- Environmental
- Inventory
- Operating
- Removal

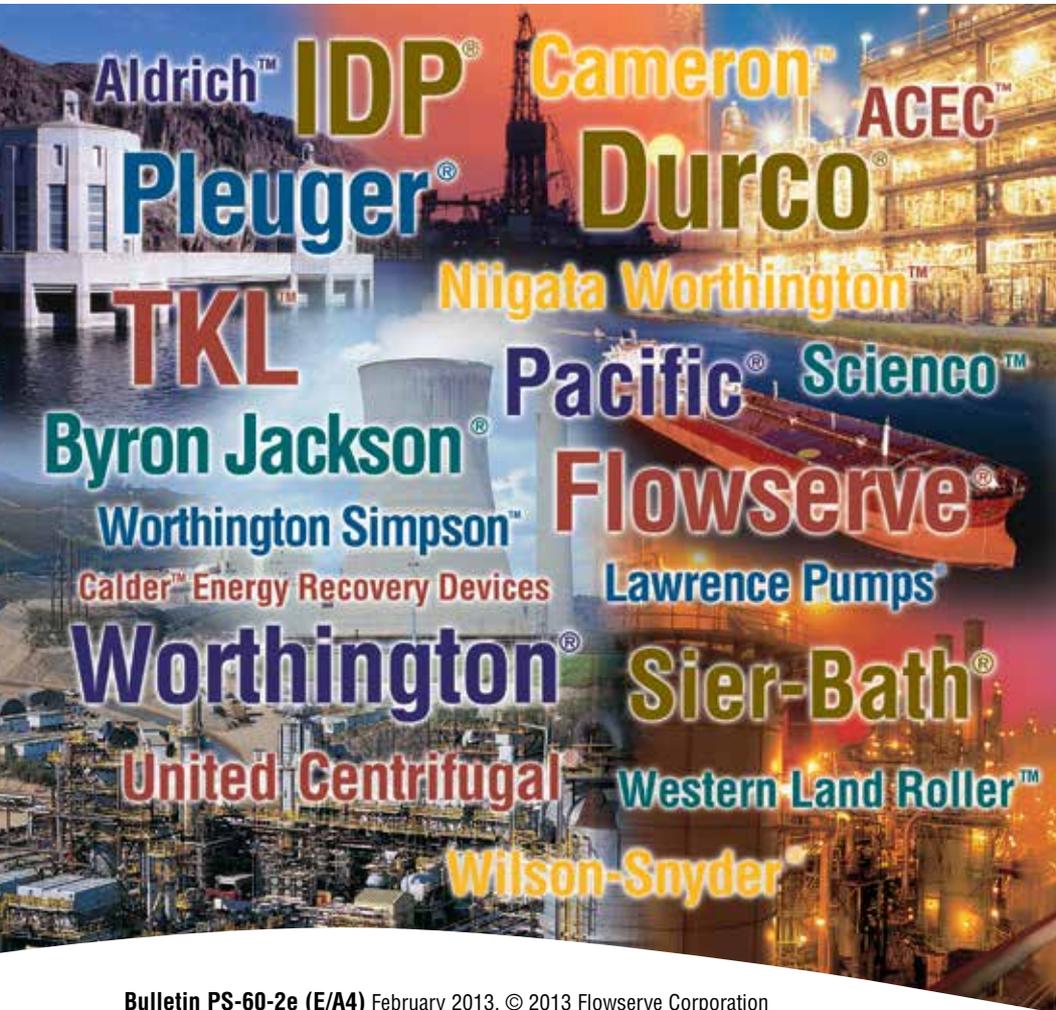
Innovative Life Cycle Cost Solutions

- New Pump Selection
- Turnkey Engineering and Field Service
- Energy Management
- Pump Availability
- Proactive Maintenance
- Inventory Management

Typical Pump Life Cycle Costs¹



¹ While exact values may differ, these percentages are consistent with those published by leading pump manufacturers and end users, as well as industry associations and government agencies worldwide.



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