



# *Engineered Services*

Technical Services • Maintenance and Repair Services  
Parts and Components • Project Services



*Experience In Motion*



## ***Global Service and Technical Support***

Flowserve Engineered Services focuses on providing customers with uncompromising service and support, wherever and whenever needed. Dedicated to delivering the highest quality support, Flowserve Engineered Services integrates hydraulic, mechanical and materials engineering knowledge with creative solutions.

A worldwide network of service and repair centers staffed by highly skilled engineers and technicians is available around the clock, seven days a week to respond to customer queries, to evaluate and troubleshoot problems and to provide reliable solutions.

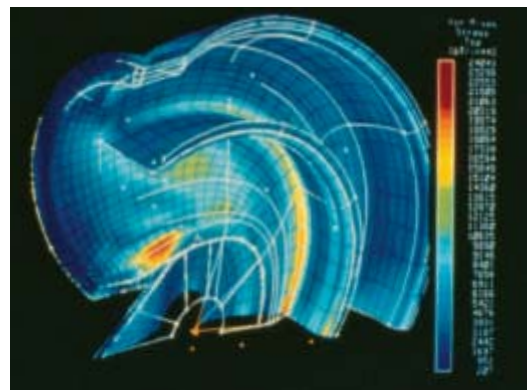
### ***Strength of Experience, Commitment to Excellence***

Flowserve has long served industries requiring superior equipment performance and service life.

- Oil and gas production
- Hydrocarbon processing
- Chemical processing
- Water resources
- Power generation
- Nuclear
- Mining and mineral processing
- Pulp and paper
- General industry

### ***Business Partner***

Flowserve partners with customers to respond to the dynamic business conditions that affect them. Flowserve works with customers to improve efficiency, maximize throughput and control process quality. Whether customer needs involve on-site technical assistance or broader project planning with full turnkey responsibility, Flowserve Engineered Services delivers professional, reliable results.





**Uniquely Positioned to Provide Value-Added Engineered Services**

The goal of Flowserve is to share the responsibility for improved operational performance, lower equipment ownership costs and increased revenues for its customers.

Unique in its world-class expertise in pumps, valves and mechanical seals, Flowserve is able to manage the performance and cost of the entire fluid system, not just the pump. In this way, Flowserve can assume responsibility for plant performance metrics other manufacturers cannot.

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## ***Technical Services***

Flowserve has developed and implemented countless hydraulic, mechanical and metallurgical upgrades for its customers. From highly engineered hydraulic modifications to full-scale equipment exchange programs, Flowserve has the engineering expertise and physical resources to address changing system requirements and problematic equipment.

### ***Hydraulic Re-rates and Upgrades***

Flowserve has extensive experience in implementing solutions that increase pump efficiency, lower NPSH requirements or adapt equipment operating performance. Whether system requirements have changed or plant output needs debottlenecking, Flowserve can execute solutions that enhance performance, improve reliability and reduce operating costs.

- Optimization of lip and shroud clearances (A/B/C gap)
- Impeller modifications
- High efficiency rotors
- Low flow modifications
- Rebowls
- Biased wedge impellers
- De-staging or upstaging
- Rotating speed changes
- Optimized hydraulics to reduce erosion/abrasion

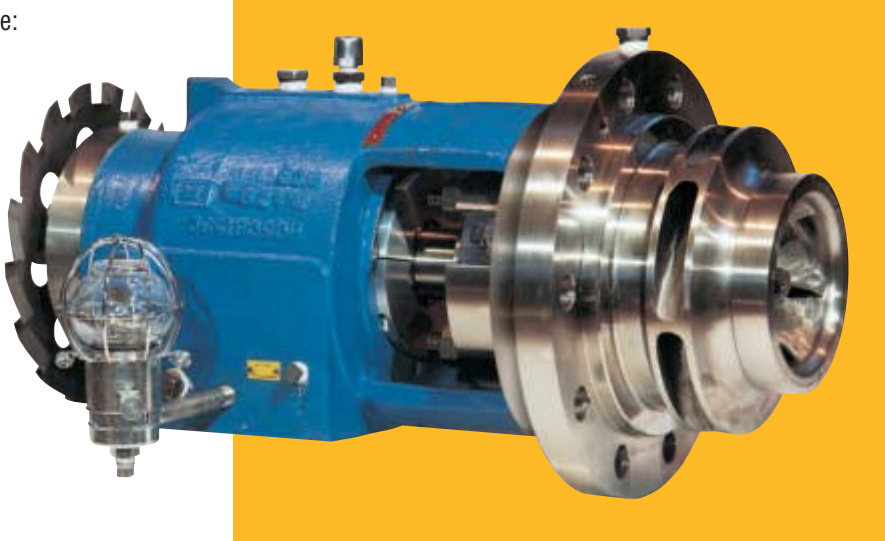


*Balance valve and thrust bearing housing upgrades extend the life of between bearings pumps*

### **Mechanical Upgrades and Retrofits**

Unreliable and leaking pumps can be refurbished to as-new condition through various mechanical upgrade and retrofit options. Flowserve Pump Improvement Engineers diagnose the root causes of mechanical pump failure and recommend solutions to improve reliability, reduce emissions and increase plant uptime.

- **API Latest Edition** upgrade programs bring out-of-date process pumps to current API standards, thereby avoiding costly, new equipment investment.
- **Power End Exchange Programs** for ANSI and ISO process pumps allow quick and hassle-free replacement of power ends without the need for protracted, expensive maintenance.
- **Other Mechanical Upgrades** include:
  - Increased rotor stiffness
  - Bearing housing and bearings
  - Mechanical seal
  - Seal chamber
  - Coupling
  - Wear ring
  - Materials





## Materials Upgrades

The proud heritage of Flowserve includes unsurpassed expertise in the development, processing and application of metallic and non-metallic materials to: increase corrosion and erosion resistance; prevent wear and galling; and maintain critical pump clearances. Flowserve materials engineers consult with customers to explore the application of new or improved materials to extend equipment life, improve performance and lower total ownership costs.

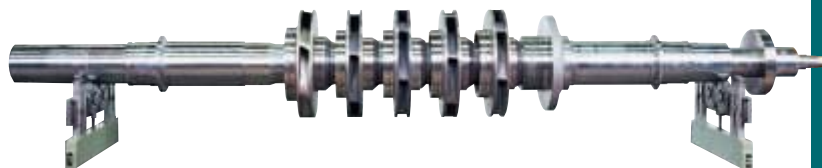
### Welding and Overlay Services

Flowserve service centers and manufacturing facilities employ advanced materials processing techniques to significantly extend component life by increasing resistance to wear, corrosion and erosion. These include:

- Laser hardening
- Plasma transferred arc welding (PTA)
- High-velocity oxygen flame spray (HVOF)
- Diffusion alloying

### Superstraight™ Shafts

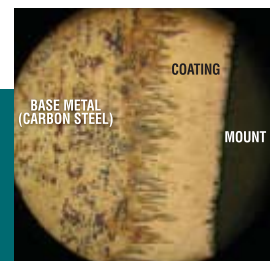
Applied to 410 martensitic stainless steel, the proprietary superstraight heat treatment method inhibits distortion of shafts during operation. As a result, excess vibration is virtually eliminated. Superstraight shafts provide trouble-free operation in vertical and horizontal pumps prone to undesirable shaft distortion.



## Materials Selection

Whether evaluating alloys for difficult applications, converting to non-metallic materials or upgrading wear components, Flowserve customers can select from numerous advanced materials engineered to extend equipment life and lower total ownership costs.

- Wear-resistant materials such as high chrome iron
- Cavitation-resistant materials such as X-Cavalloy
- Corrosion-resistant alloys and non-metallics
- Non-metallic bearings
- Distortion-resistant materials



## Diffusion Alloying

Diffusion alloying creates a layer of inter-metallic compounds formed by the addition of elements to the surface of a part. This process does not coat the base material. Instead, by reacting elements under controlled temperature, time and atmospheric conditions, the surface of the part is converted to a new material. Typical hardness for converted surfaces ranges from 1650 to 1850 KHN. As a comparison, hardened tool steel is typically only 925 KHN. Flowserve uses qualified TMT<sup>1</sup> diffusion alloying processes to reduce the effects of wear, erosion, corrosion and galling for critical pump components, thereby extending equipment life by years, not just months.

<sup>1</sup> Processes developed by Turbine Metal Technology, Tujunga, California, U.S.A.



**Analytical and Diagnostic Services**

Flowserve global engineering resources provides technical services to plant maintenance and reliability personnel dealing with problematic equipment. Equipped with advanced analytical and diagnostic tools, Flowserve Pump Improvement Engineers can pinpoint even the most obscure equipment problems.

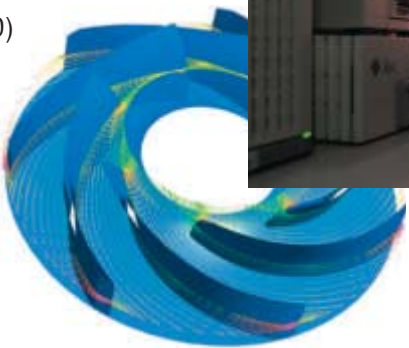
**On-site Pump System Analysis and Engineering**

Flowserve on-site engineers are equipped to collect real-time operational data and to review performance problems through equipment surveys and operating history reviews. Findings are analyzed and reported to the customer along with recommendations to improve system performance and equipment reliability.

**Computer-aided Analysis**

Expert engineers use the latest, proven engineering tools and analytical techniques to support reliability- and performance-based improvement projects for rotating equipment. Services include:

- Stress analysis
- Thermal analysis
- Dynamic analysis
- Computerized fluid dynamics (CFD)
- Flow visualization
- Finite element analysis (FEA)
- Structural analysis
- Failure analysis
- Vibration, pulsation and noise analysis



**Vibration Analysis**

Vibration spectra indicate the health of a pump.

Vibration analysis is helpful in diagnosing equipment problems and is useful for making predictive maintenance decisions. When combined with knowledge of the pump's design, its operating characteristics and maintenance history, vibration analysis can reveal the root causes of equipment failure.

Using this information, Flowserve engineers can recommend and develop pump improvements that will enhance pump performance and increase operability and efficiency.





## ***Reliability and Energy Improvement***

### **Increased Equipment Reliability and Efficiency**

Flowserve helps customers institute comprehensive programs that improve the reliability and the operating efficiency of pumps and related equipment. With the full support of Flowserve technical services, Pump Improvement Engineers work with customers to define and establish performance metrics based on customer goals. These may include:

- Improved plant or process uptime
- Increased mean time between planned maintenance (MTBPM)
- Reduced emissions
- Energy consumption reduction

### **Intelligent Pumping Series**

Ensuring reliability and reducing ownership costs of critical plant equipment are an essential part of any plant operation. The Intelligent Pumping Series (IPS) offers unprecedented advances in monitoring and controlling critical process pumps by adding sophisticated hardware and diagnostics software to the pumping system.

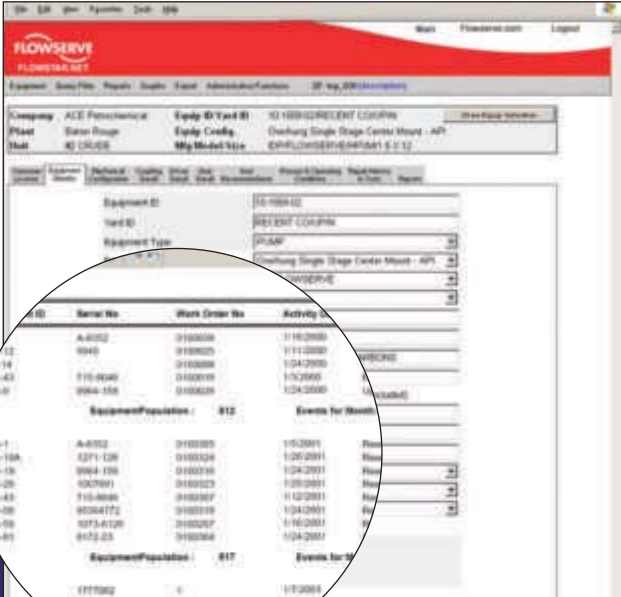
The IPS is capable of monitoring and logging critical data such as vibration, process fluid temperature and pressure, seal chamber temperature and pressure, bearing temperature and more. Equipment protection and operating schemes range from fault condition shutdowns to intelligent motor speed control based on various combinations of operating parameters. Wireless technology allows remote monitoring of operating data by either plant personnel or Flowserve engineers.





### Managing Assets for Improved Performance

In today's competitive economy, pump users must strive to operate equipment with peak efficiency and high reliability. World class operational performance demands maximum equipment availability, predictable throughput and stable process quality. Equipped with advanced diagnostic tools and specialized asset management tools to maximize asset performance and reduce the total cost of ownership, Flowserve engineers and technicians deliver proven results and a competitive market advantage for customers.

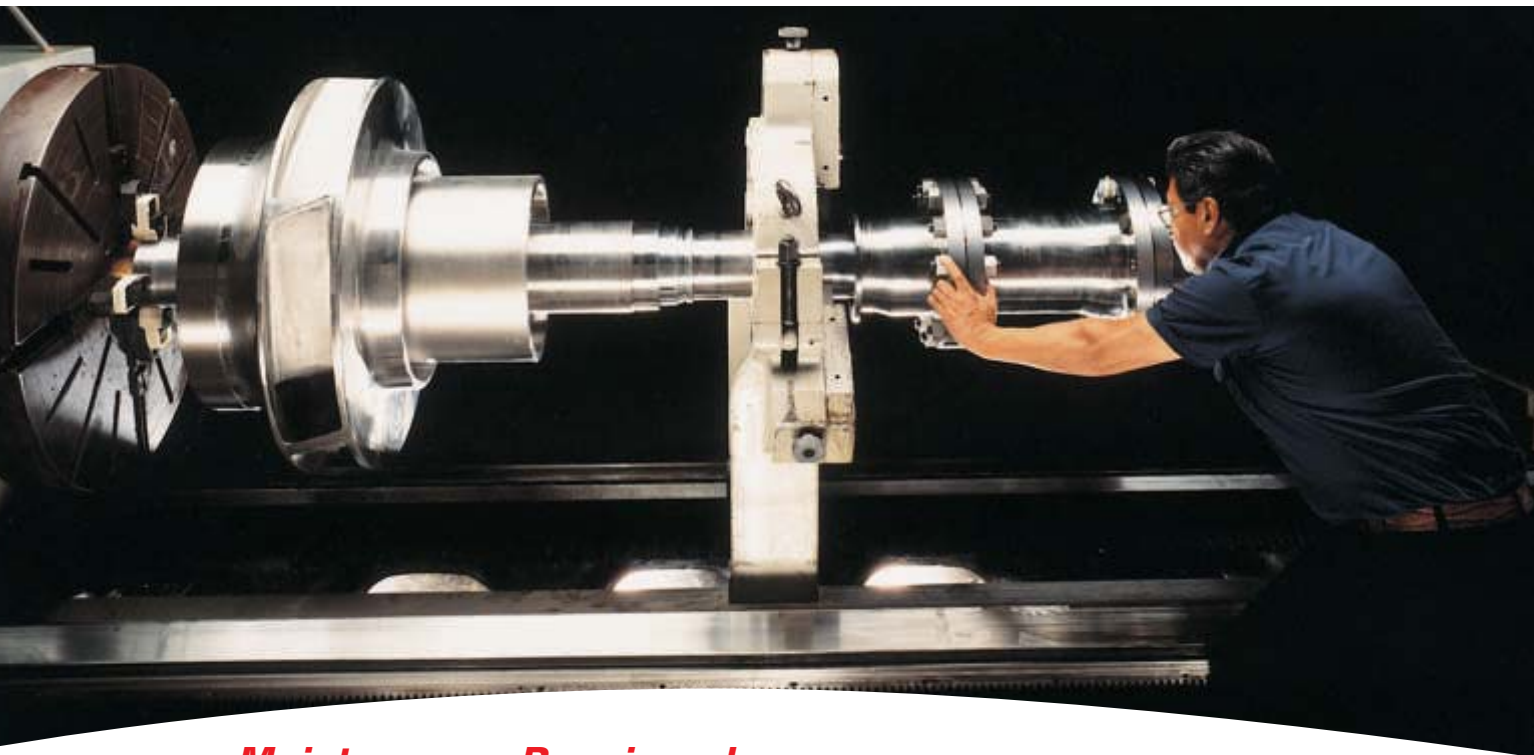


### Reducing Total Cost of Ownership

Lost production, maintenance expenses and energy consumption represent the major costs of ownership for pump users. Flowserve maintains a qualified staff of strategically located Pump Improvement Engineers to provide the technical support customers need to reduce total cost of ownership.

One critical component of the Flowserve asset management and total cost of ownership reduction program is Flowstar.net. Used in conjunction with predictive maintenance technologies, Flowstar.net is the heart of an effective reliability program.

This Web-based reliability improvement software offers access to data 24 hours a day. Using this data, the Flowserve asset management team can work with clients to identify and evaluate problematic equipment and analyze root causes. Pump users can make timely, informed decisions to reduce maintenance costs, improve efficiency and minimize unplanned shutdowns.



## ***Maintenance, Repair and Inspection Services***

With more than 70 service and manufacturing facilities worldwide and one of the industry's most extensive on-site service and repair fleets, Flowserve customers have access to unparalleled technical expertise, manpower and diagnostic equipment, off-site or on-site.

Flowserve service center technicians have the experience and capability to properly repair and maintain critical process equipment. Broad machining capabilities, advanced material overlay technology, progressive inspection techniques and materials expertise are all integral parts of the Flowserve repair portfolio. Customers are ensured high quality repair and maintenance practices that focus on prolonging equipment life and improving safety.

Through Flowserve, customers have access to one of the largest on-site service and repair fleets in its industry including fully-equipped service vehicles, mobile machine shops and highly qualified project managers, field engineers and technicians.

Whether commissioning a new plant, collecting performance data, troubleshooting a problematic pump or performing in-field machining, customers can rely on Flowserve to provide the manpower and tools necessary to meet their needs.





**Repairs – Welding, Machining and NDE**

Flowserve technicians can repair most types of equipment, including pumps, motors, compressors, agitators, valves and seals. With its numerous service centers and its fleet of mobile machine shops, Flowserve has the resources to manage equipment repairs on-site or off-site.

Flowserve service technicians can provide any of the following repair services:

- Mechanical overhauls ranging from simple power-end maintenance to complete hydraulic-end overhauls
- Machining, including lathe work, milling, drilling, boring, lapping and more
- Certified repair welding via multiple processes
- Barrel boring for multistage pumps and other rotating equipment
- Baseplate and foundation restoration and repair of hollow cavities
- Parts manufacturing and sourcing, including rapid turnaround on critical parts from Flowserve manufacturing plants and qualified suppliers

To further contain equipment repair costs, Flowserve has the technical resources to provide on-site evaluations of existing components. Through visual, dimensional and non-destructive examinations, Flowserve personnel can recommend safe and economical equipment repairs as necessary.





### ***Contract Maintenance***

Flowserve contract maintenance programs reduce total operating and maintenance expenses while optimizing critical manpower. By supervising maintenance and repair activities at the customer site, Flowserve enables customers to focus on core production activities. Under Flowserve project supervision, resources are efficiently deployed to meet maintenance and repair requirements.

Contracts are tailored to meet customer needs and may include the following services:

- Equipment removal and installation
- Mechanical overhauls, repairs, machining and balancing
- Preventive maintenance programs
  - Scheduled inspections
  - Vibration and noise monitoring and analysis
  - Lubrication analysis and service
  - Motor amperage monitoring
- Inventory management
  - Evaluating, monitoring and reducing spare parts to reduce non-productive asset costs
- Component evaluations
  - Visual, dimensional and non-destructive examinations to determine components' condition
- Labor resource management



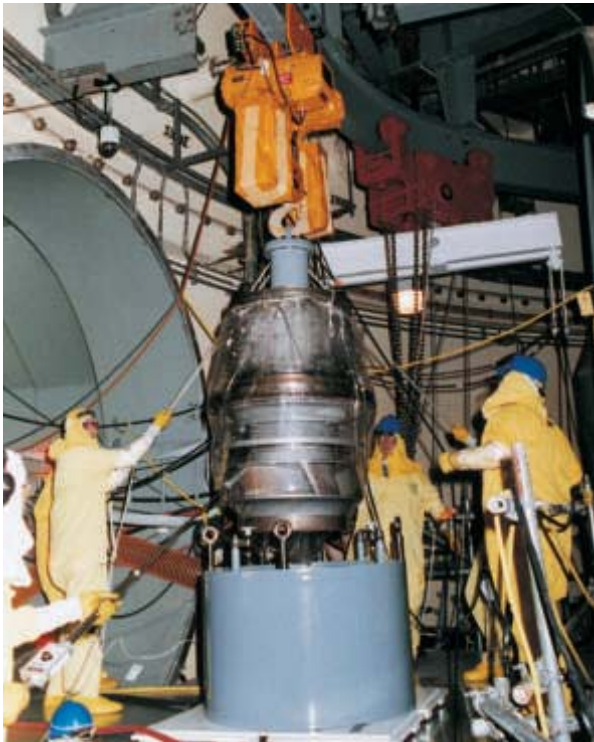


***Outage and Mechanical Services***

Flowserve has extensive experience and resources to provide integrated outage and mechanical services. Field service teams offer rapid mechanical assistance, including maintenance, upgrade and inspection services.

***Field Performance Testing***

Field performance testing is used to determine pump operating conditions and to plan maintenance and repair activities. Planned maintenance often can be postponed or avoided if test data indicate satisfactory operation at the time of planned maintenance. This results in lower maintenance costs and increased customer profits.



***Field Supervision***

With lean and overburdened staff, customers often do not have the resources in-house to supervise ongoing, equipment-related activities. Flowserve can provide experienced field engineers and project managers to complement plant maintenance crews and independent contractors in the following activities:

- Equipment removal and handling
- Equipment transportation
- Maintenance activities
- Equipment installation
- Start-up and commissioning



## Parts and Components

Quality OEM parts for the entire range of Flowserve products are readily available from a worldwide network of parts manufacturing centers, service centers, fast response centers and regional parts service offices. Parts conform to the latest design standards and material specifications so customers are ensured reliable operation and lowest equipment ownership costs. Flowserve manufactures, stores and distributes parts for all of its proud heritage brands.

ACEC™ Centrifugal Pumps  
 Aldrich® Pumps  
 Byron Jackson® Pumps  
 Cameron® Pumps  
 Durco® Pumps  
 Flowserve® Pumps  
 IDP® Pumps  
 Jeumont-Schneider™ 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® Pump

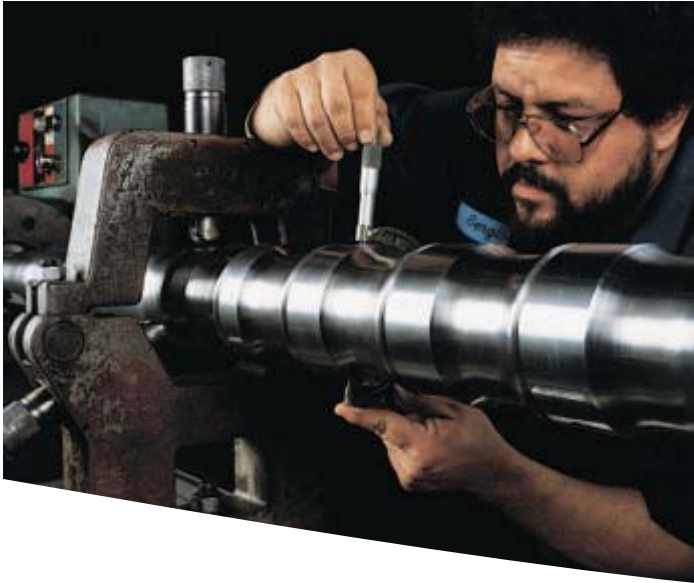
Flowserve can also re-engineer and produce non-Flowserve components for equipment that is now obsolete or where the original equipment manufacturer cannot be located.

### *The Flowserve Advantage*

The use of replicated or locally machined parts can compromise mechanical integrity, hydraulic efficiency and personnel safety.

Flowserve manufactured parts offer significant benefits to customers. As an OEM, Flowserve engineering and manufacturing operations understand the critical elements involved in designing and producing high quality parts. Whether cast or machined, Flowserve manufactured parts and components result in lower total operating costs and increased personnel safety.

- Flowserve casting quality is superior. Poor surface finishes, internal shrinks, tolerance deviations and non-compliant compositions are commonly found in non-OEM parts. These result in poor hydraulic efficiency, high power consumption, premature failure and increased operating costs.
- Flowserve parts incorporate the latest design changes that are routinely implemented to improve operating efficiency and extend equipment life
- Customers benefit from ongoing research and development efforts to develop new materials, overlay techniques and mechanically improved components



### ***Quick Response Programs***

Flowserve quick response centers provide customers with rapid delivery of pumps and parts to minimize equipment or plant downtime. Flowserve quick response centers respond rapidly to customer needs by providing same-day delivery of standard parts. Special parts can be delivered in days instead of weeks. They also have machining capabilities to provide customer-specific adaptations. With the help of Flowserve quick response centers, pump users can maximize plant uptime and profitability.

### ***Inventory Management***

By evaluating and monitoring client-held inventory, Flowserve parts and inventory experts develop programs to reduce customer costs associated with inventory and non-productive assets. Programs incorporate Flowserve and non-Flowserve equipment.

- Inventory rationalization
- Safety stock recommendations
- Materials standardization
- Equipment obsolescence
- Repair schedule integration

Through quick response programs, rapid prototyping and other innovative approaches to OEM parts supply, Flowserve delivers lower inventory costs while maintaining high levels of equipment performance.

### ***Wear Ring Quick Response Program***

Wear ring size, clearance and material are critical to a pump's efficiency, thrust load characteristics and its ability to withstand the dynamic forces associated with start-up and shutdown. While typically replaced during equipment overhauls, wear rings often have unique dimensions that make stocking the proper sizes difficult. As a result, many pump users have sought alternative sources to meet pump repair lead time requirements. Unknowingly, however, many users adversely impact pump performance by using suppliers who do not have the application knowledge or engineering expertise to produce effective wear rings.

The Flowserve Quick Response Wear Ring Program offers quick turnaround for the most common sizes and material combinations of wear rings. Flowserve can manufacture and ship wear rings to OEM specifications or with special ID or OD dimensions on the next business day. This program helps to reduce inventory expenses and pump repair cycle times while improving pump performance and reliability.



## ***Project Services***

Customers are under increasing pressure to complete projects cheaper, smarter and faster. Flowserve can provide the resources to manage even the most complex project from start to finish.

### ***Front-end Engineering Consultancy***

Whether in the pre-procurement phase of new construction or in the midst of a process change implementation, Flowserve can provide front-end services to maximize long-term performance and reliability. Typical front-end services include:

- System analysis and optimization
- Material selection and testing
- Debottlenecking
- Energy efficiency optimization

### ***Project Management***

Large scale projects such as plant commissioning, critical equipment overhauls or energy improvement initiatives require resource planning, timeline management and budgeting services. Flowserve on-site project managers and engineers successfully see projects to completion.





***Installation and Commissioning Services***

Flowserve field service teams provide a broad range of services to support customer start-up requirements.

- Equipment installation
- Pipe and pump bolt-up, alignment and inspection
- Motor pre-rotation checks
- Equipment foundation installation and inspection
- Baseline vibration and operating characteristic testing
- Valve performance testing
- Start-up and operating procedure development
- Transition documentation
- On-site training





## ***Global Engineered Services***

With an installed base of more than one million pumps, Flowserve Pumps has sales offices, service centers and manufacturing facilities all over the world. As a result of its extensive global footprint, Flowserve is ideally positioned to deliver best-in-class solutions to successfully address the world's most challenging projects.





## ***Pump Supplier to the World***

Flowserve is the driving force in the global industrial pump marketplace. Few if any pump companies can match the capabilities in hydraulic engineering, mechanical design or materials science that Flowserve possesses.

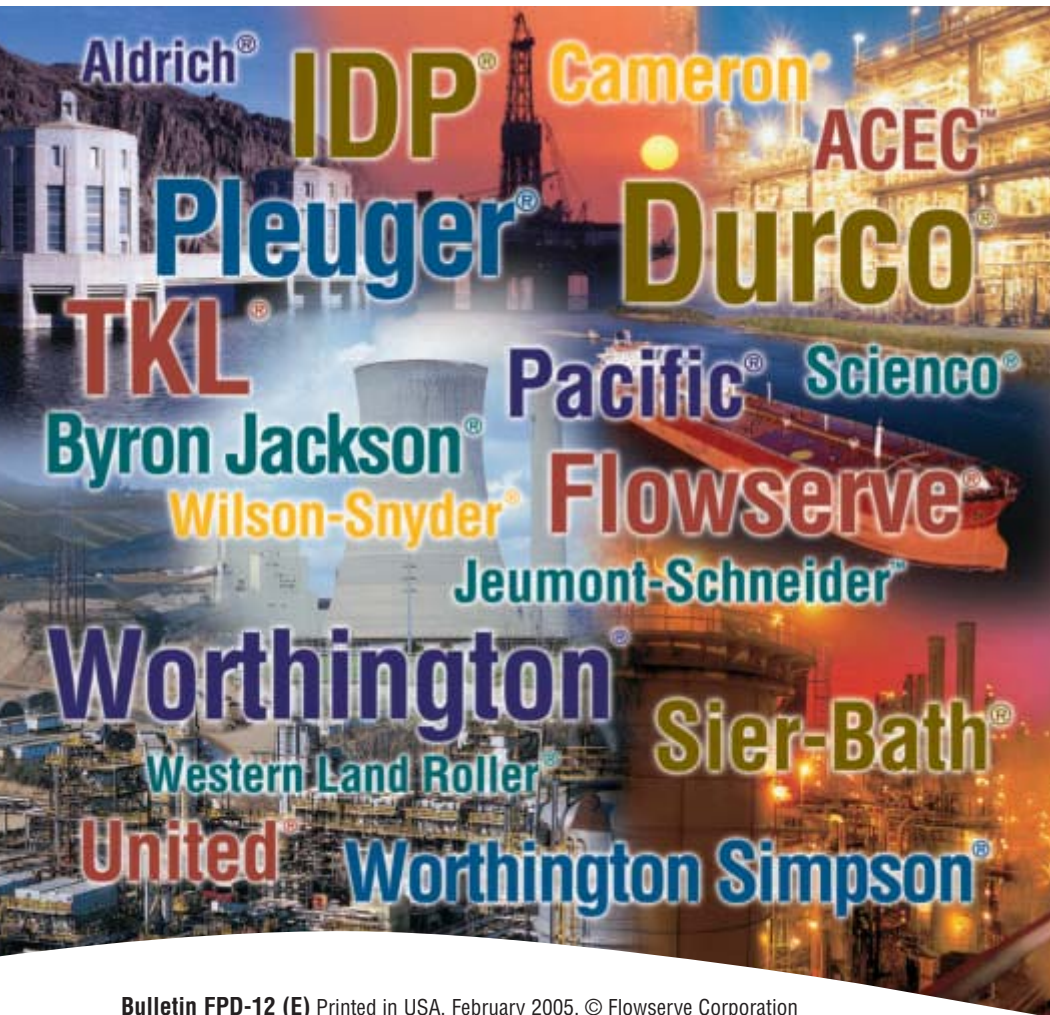
### ***Pump Designs***

Flowserve offers a wide range of complementary pump types, built to recognized global standards and customer specifications. 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.



### ***Heritage Names of Distinction***

- ACEC™ Centrifugal Pumps*
- Aldrich® Pumps*
- Byron Jackson® Pumps*
- Cameron® Pumps*
- Durco® Pumps*
- Flowserve® Pumps*
- IDP® Pumps*
- Jeumont-Schneider™ 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*



**USA and Canada**

Flowserve Corporation  
Pump Division  
5215 North O'Connor Blvd.  
Suite 2300  
Irving, Texas 75039-5421 USA  
Telephone: 1 972 443 6500  
Telefax: 1 972 443 6800

**Europe, Middle East, Africa**

Flowserve Corporation  
Pump Division  
Parallelweg 6  
Etten-Leur 4878 AH  
The Netherlands  
Telephone: 31 76 502 8300  
Telefax: 31 76 502 8359

**Latin America and Caribbean**

Flowserve Corporation  
Pump Division  
6840 Wynnwood Lane  
Houston, Texas 77008 USA  
Telephone: 1 713 803 4434  
Telefax: 1 713 803 4497

**Asia Pacific**

Flowserve Pte. Ltd.  
Pump Division  
200 Pandan Loop #06-03/04  
Pantech 21  
Singapore 128388  
Telephone: 65 6775 3003  
Telefax: 65 6779 4607

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For more information about Flowserve Corporation,  
visit [www.flowserve.com](http://www.flowserve.com) or call USA 1 800 728 PUMP (7867)