A trusted partner to the oil and gas industry

Flowserve offers the world’s most complete line of ISO 13709/API 610 pumps with the widest range of hydraulic coverage, pressure and temperature capabilities. Its engineering expertise, applications know-how and installation experience are peerless. For more than 150 years, Flowserve has proven itself to be the world leader in meeting the changing and demanding needs of the oil and gas industry. Its ability to understand the industry’s high-pressure pumping needs is evidenced by its numerous innovative water injection pump designs.

Committed to the complete pump system lifecycle

For more than two centuries, Flowserve has served industries requiring solutions that add value and reduce costs throughout the lifecycle of a pumping system.

- Oil and gas
- Power generation
- Chemical
- Water
- General industry

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, equipment upgrades or broader project planning with full turnkey responsibility, Flowserve delivers professional, reliable results.
The preferred choice for water injection pumps

Water injection is one of the key technologies oil and gas producers rely on to increase recovery rates. Trends toward higher pressures and more corrosive and erosive fluids create significant pumping challenges. Operations require efficient pumps that can reliably perform under high pressures for extended periods.

A comprehensive portfolio

Flowserve offers several pump designs to address the industry’s needs. From axially split, multistage (BB3) units to diffuser- or volute-type double case (BB5) models, Flowserve water injection pumps are built to customer specifications, often exceeding the requirements of ISO 13709/API 610. Models include:

- **DMX** – High-pressure multistage, axially split pump
- **WCC** – High-pressure, medium-duty, diffuser-style double case pump
- **HDO** – High-pressure, heavy-duty, volute-style double case pump
- **WIK and WIKO** – High-pressure and ultra high-pressure, heavy-duty, diffuser-style double case pumps

A foundation of innovation and leadership

Since 1926, when it developed the first double case pump for hot oil, Flowserve has been in the vanguard of pump development for the oil and gas industry. This leadership position was reinforced in 1934 with the introduction of high-pressure water injection pumps and cemented in 1982 when it built one of the world’s largest water injection pumps (17,900 kW [24,000 hp]).

Reflecting its leadership position, Flowserve continues to be involved in establishing the ISO 13709/API 610 standard governing the construction of these and other pumps for the oil and gas industry.
The Flowserve DMX pump is fully compliant with ISO 13709/ API 610 (BB3), latest edition. It is engineered and built for high-pressure, heavy-duty water injection applications. Boasting a comprehensive range of hydraulic coverage, the DMX permits precise selection to ensure the best hydraulic fit, operating efficiency and stability. This helps to minimize operating expenses and extend mean time between repair.

Operating parameters

- Flows to 2950 m$^3$/h (13,000 gpm)
- Heads to 2130 m (7000 ft)
- Pressures to 275 bar (4000 psi)
- Temperatures to 200°C (400°F)
- Speeds to 6000 rpm

Features and benefits

**Heavy-duty, axially split casing** features double volutes positioned 180 degrees apart so hydraulically generated radial loads are balanced.

**Opposed impeller configuration** effectively balances axial thrust over a wide range of operating conditions.

**Raised face flanges** meet ASME B16.5 dimensional criteria. Class 600 suction and discharge minimum. High-pressure casings and Class 900 and 1500 are also available.

**Nozzles** are integral with the lower half casing, permitting disassembly of the pump without disturbing piping connections. Nozzles are designed to handle external forces and moments equal to or in excess of ISO/API specified figures.

**Cap nuts** on the top half casing parting flange allow easy casing removal for inspection and maintenance.

**Split center bushing** enables inspection and dynamic balancing of the rotor without dismantling.

**Seal chamber** is designed to ISO 21049/API 682 dimensional criteria. This design allows for installation of cartridge-type mechanical seals to meet the required safety and environmental requirements.

**Replaceable casing and impeller wear rings** control interstage leakage and provide hydraulic stability. Optional laser-hardened, HVOF-overlaid or non-metallic wear rings in Graphalloy®, PEEK® and other materials may be specified.

**Materials** of construction are selected to meet specific service requirements. Available materials include carbon steels, chromium steels, austenitic stainless steels, duplex stainless steels and super duplex stainless steels.

**Certified testing** is performed on each DMX pump prior to shipment.

® Graphalloy is a registered trademark of Graphite Metallizing Corporation.

® PEEK is a registered trademark of Victrex plc Corp.
Hydraulically balanced performance

The DMX is engineered to perform reliably at the required hydraulic capacity while mitigating thrust loads. With as many as 14 stages to produce the required hydraulic capacity, the pump’s opposed impeller mounting arrangement effectively balances axial thrust over a broad operating range. Its double volute casing ensures hydraulically generated radial thrust loads are offset. Shaft deflection and vibration are virtually eliminated, resulting in prolonged bearing and seal life.

Robust rotating element

The DMX’s robust rotating element includes large-diameter shafts and short bearing spans to minimize deflection. Final two-plane dynamic balancing and TIR verifications are conducted on assembled rotors to ensure optimum mechanical performance throughout the operating range. Shaft size is selected to suit power and speed requirements.

Multiple bearing designs

The DMX is offered with a variety of bearing designs to meet application requirements. The standard radial bearing is a self-aligning, antifriction type. The thrust bearing consists of the two single-row, angular-contact antifriction bearings.

Standard lubrication is via an oil ring system and incorporates a constant-level oiler and a sight glass. This system prolongs bearing life by ensuring oil penetrates the bearings without foaming.

Other bearing designs include the following:

- Split sleeve radial and ball thrust
- Split sleeve radial and tilting pad thrust
WCC
high-pressure, medium-duty, diffuser-style, double-case pump

The WCC is a multistage, diffuser-type barrel pump with a tandem impeller rotor and a single-diameter balance drum to compensate for residual axial thrust. The standard cartridge-type construction facilitates rapid changeout with a spare to minimize lost production. When process requirements demand a fully compliant, ISO 13709/API 610 (BB5) pump but also call for a flexible, cost-efficient solution, the WCC pump is the optimum choice. With its extensive list of options and metallurgical choices, it can fit almost any water injection application.

Operating parameters

- Flows to 1020 m³/h (4500 US gpm)
- Heads to 4270 m (14,000 ft)
- Pressure ratings to 270 bar (4000 psi)
- Temperatures from -5°C to 430°C (-20°F to 800°F)
- Speeds to 7000 rpm

For parameters outside these limits, contact Flowserve.

Features and benefits

**Wrought shafts** are incrementally stepped at each impeller fit for ease of assembly. Shafting is generously sized and machined to tight tolerances to minimize vibration.

**Precision-cast impellers** ensure optimum hydraulic efficiency and performance repeatability. Impeller wear surfaces are engineered for the best possible performance. Standard materials can be upgraded with overlay materials like Stellite® or surface treatments like laser hardening for better durability.

**Multi-vane diffusers** balance radial loads over the operating range while maximizing efficiencies at the duty condition. A continuous metal-to-metal seal between stage pieces minimizes risk of internal leakage.

**Seal chambers** are engineered to accommodate cartridge seals using ISO 21049/API 682 design criteria. Multiple seal designs are available to meet site-specific requirements.

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**Single-diameter balance drum**
A single-diameter balance drum compensates for residual axial thrust produced by the tandem-impeller arrangement. The drum is designed to be plain or serrated as appropriate for the application to reduce leakage and optimize reliability and efficiency. It is installed via an interference fit against a step in the shaft and located axially with a split ring. A flanged drum design is optional.

**Materials of construction**
The materials of construction of the WCC’s barrel casing and discharge head meet ISO 13709/API 610, latest edition, Column S-6 and above. They include:
- Carbon steel
- High-chrome steel
- Austenitic stainless steel
- Duplex stainless steel
- Super duplex stainless steel
Special materials are available to meet customer requests or specific application requirements.

**Barrel pressure rating**
All pressure boundary components are designed in accordance with ASME standards to meet the application requirements. The suction portion of the WCC barrel is engineered as a split pressure rated design. Sealing is metal-to-metal with fully confined, controlled compression gaskets that ensure proper sealing and alignment when handling hot liquids.

**Numerous nozzle configurations**
The standard nozzle configuration on the WCC is top suction, top discharge. It may be configured side suction, side discharge as an alternative.

Flange facing is raised face as standard with ring joint optional. Flange ratings range from 600 to 2500 lb to suit the application.

**Robust bearing system**
The standard bearing system on the WCC pump consists of heavy-duty journal radial bearings and self-equalizing, tilting pad thrust bearings due to their reliability and versatility.

The following optional bearing arrangements are available:
- In lower-energy applications, antifriction bearings can be supplied as a cost-saving alternative either in conjunction with self-lubricated sleeve bearings or as a complete antifriction configuration, as permitted by ISO 13709/API 610 (BB5). Air, fan or water cooling is available as needed to suit the application requirements.
- When space is at a premium, an integral lubrication circulation system can be supplied. This system offers the benefits of circulation while maintaining a compact size and minimizing maintenance demands.

**Optional back-to-back rotor**
An available back-to-back rotor design ensures hydraulic balancing of the axial thrust. The center bushing and sleeve ensure improved rotor dynamics by adding rotor stability and low vibration levels for higher stage counts, even for low-density applications.
Rated for the most severe water injection conditions, Flowserve HSO and HDO special purpose pumps are manufactured to the strictest design criteria, often exceeding ISO 13709/API 610 (BB5). These pumps feature opposed impellers and dual volute designs, resulting in nearly balanced axial hydraulic thrust over the full operating range of the pumps. Single-suction (HSO) or double-suction (HDO), first-stage impellers provide the flexibility to meet a variety of NPSH requirements.

Operating parameters
- Flows to 4000 m³/h (17,600 US gpm)
- Heads to 5365 m (16,000 ft)
- Pressures to 450 bar (6525 psi)
- Temperatures to 425°C (800°F)
- Speeds to 9000 rpm
- Electric motor or gas turbine drive

Features and benefits
Double volute casing design consists of hydraulically identical halves with volutes 180 degrees apart. This design essentially balances radial loads at all operational points, reducing harmful vibration and ensuring dependable performance.

Precision-cast opposed impellers improve hydraulic efficiency and performance repeatability. Impellers are secured to the shaft with a shrink-fit. Axial movement is prevented by split rings.

Optional grooved impeller running fits increase the pump’s tolerance to foreign materials and desensitize it during startup, stopping and system transients.

Extra-long center stage piece breaks down 50% of the discharge pressure to the intermediate stage before the long crossover. It is overlaid with a hard wear surface to eliminate damage from the mating impeller wear surfaces.

Dynamically balanced rotor provides excellent rotor dynamic stability. The fully assembled rotor is balanced as a complete unit before installation.

Split-construction stage pieces ease installation in the volute casing.

Mechanical seals and seal chambers incorporate the latest design features of ISO 21049/API 682 to ensure maximum reliability. Multiple seal configurations are available.
Sag boring prolongs wear ring life
Sag boring is applied to all volutes nine stages and higher. The bottom volute casing is bored in incremental steps toward the center. This design accommodates the static deflection of the rotating assembly caused by its own weight when the pump is not operating. During startup, the shaft will straighten and casing rings will slide upward to maintain clearances. This process eliminates rubbing of wear rings commonly found with slender shaft and high stage counts.

Volute locating ring improves alignment
HSO/HDO pumps employ a volute locating ring (see adjacent illustration) to align and position the discharge cover and volute. This hard metal ring replaces metal spacer gaskets, which may become dislodged during assembly.

Forged barrel casing, suction and discharge heads
The barrel casing and discharge head houses the pump cartridge and is a split pressure level design. A full-discharge, pressure-rated barrel design is also available. Forged pressure containment parts are provided in the following materials:
- Carbon steel overlaid with stainless steel at all critical metal-to-metal seating fits and high-velocity areas
- Stainless steels
- Duplex and super duplex stainless steels
- Carbon steel overlaid with Inconel® on all wetted areas

Alternative materials are available to suit individual service requirements.

The bolted discharge head features only one high-pressure, fully confined, circular compression gasketed sealing joint to the atmosphere for superior reliability. An optional bolted suction head also is available.

Robust bearing system
Sleeve journal radial bearings and tilting pad thrust bearings are standard, utilizing either air, fan or water cooling as needed. Duplex ball thrust bearings are available where appropriate and permitted by ISO 13709/API 610 (BB5).

Numerous nozzle configurations
Nozzles on HSO/HDO pumps have standard raised face flanges. Nozzle orientation can be adjusted to suit site requirements. Weld-end, ring joint, and tongue and groove flanges are optional configurations.

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The uncompromising engineering philosophy adopted by Flowserve engineers when designing the WIK and WIKO pumps resulted in diffuser-style pumps that are unmatched in the industry. Fully compliant with ISO 13709/API 610 (BB5), these special purpose high-pressure and ultra high-pressure diffuser pumps include superior rotor dynamics, unequalled mechanical design, and proven records of experience in water injection service.

Typical operating parameters

- Flows to 4000 m³/h (17,610 US gpm)
- Heads to 7000 m (23,000 ft)
- Pressures
  - WIK: 450 bar (6525 psi)
  - WIKO: 650 bar (9425 psi)
- Temperatures to 450°C (840°F)
- Speeds to 9000 rpm
- Electric motor or gas turbine drive

Features and benefits

High-stiffness rotor with low static deflection is the result of large-diameter shaft and short bearing spans. This reduces the risk of accidental contact within the running clearances and improves the pump’s tolerance to operational upsets.

Multi-vane, radially split diffuser and channel ring collectors are cast components, eliminating radial imbalance across the entire operating range. Collectors provide continuous metal-to-metal sealing between stages and also between inner and outer casings. Collectors are milled to create smooth passageways and ensure repeatability of performance.

Large-diameter shafts are incrementally stepped at all of the impeller, seal and thrust collar fits for ease of assembly. Shafts are thermally stabilized to eliminate potential distortion from residual stresses.

Heavy-duty tilting pad thrust bearings the leading edge groove (LEG) pressure-lubricated, self-equalizing type.

Mechanical seals are contained within a large-diameter seal chamber designed to ISO 21049/API 682. Multiple seal designs are available.

Forged barrel casing and discharge head are precision designed for each application and manufactured from high-strength forgings to ensure unparalleled durability.

Available materials include carbon steels, duplex stainless steels, super duplex stainless steels and carbon steels with Inconel overlay.
Unique low specific speed impellers

Precision-cast low specific speed impellers are statically and dynamically balanced. Impellers are double keyed and positively secured against axial movement by split rings and a shrink-fit on a stepped shaft. Large eye, single-suction or alternate double-suction, first-stage impellers are available depending on NPSH conditions. Impeller hubs have integral hardened wear surfaces.

Single-diameter balance drum

The single-diameter balance drum compensates for the residual axial thrust produced by the tandem impeller arrangement. The sleeve is grooved against the flow to improve rotor stability, lower balancing leak-off flow, and reduce the risk of galling in the running clearance. It is mounted with a shrink-fit key driven and located with a split ring.

Back pullout, cartridge construction

The standard cartridge-style inner case subassembly includes the rotor, diffusers, discharge head, suction head, seals and bearing assemblies. This cartridge construction eases maintenance by allowing quick replacement of the entire subassembly. Major assembly, disassembly, and mechanical seal and rotor settings can then be performed in the shop, rather than in the field.

WIKO: Innovative opposed impeller design for ultra-high pressures

The WIKO pump was developed to meet ever-increasing customer requirements for extreme discharge pressures and the need to balance residual axial thrust. By pairing an opposed impeller rotor with diffuser collectors and a single-diameter balance drum, this design can be customized to meet higher pressures.

Every WIKO pump is custom designed and built to order for specific ultra high-pressure applications.
Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing and selection, installation, operation, and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Instructions included with the product, and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

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