

# Multiple Screw Pumps for Upstream Applications

The oil and gas industry offers a wide range of upstream applications to screw pumps. Besides the single screw pump, better known as the progressive cavity pump, pumps with multiple screw arrangements are in use for a large variety of duties in upstream applications, both onshore and offshore.

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Screw pumps are rotary positive displacement pumps, which have certain advantages over other pump designs as centrifugal pumps or reciprocating pumps:

- The capability of handling liquids with low or very high viscosities.
  - Higher efficiencies, hence, lower power requirements.
  - Low shear pumping of oil/water mixtures and crude oil emulsions.
  - Pump flow rate almost independent of the back pressure.
  - Self priming with high suction capability.
  - Smooth and almost pulsation-free operation with low noise level.
  - Capable of handling liquids with entrained gas.
- Multiphase pumps can handle up to 100 percent gas.

- Easy flow control by speed variation.

Founded in 1905, Leistriz, with headquarters in Nuernberg, Germany, is one of the largest global manufacturers and suppliers of screw pumps. The product program offers a vast range of screw pumps for upstream applications.

### Three-Rotor Screw Pumps

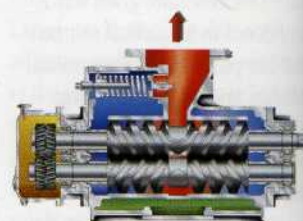
A set of three screws is installed in a pump casing. The centre screw drives the idler screws which are located on either side. The pumped product is carried in cavities formed between the three screws and the casing from the suction to the discharge side of the pump. A hydrodynamic liquid film between the drive screw and the idlers prevents immediate contact between

the screws and ensures friction-free operation with no wear. Internal hydraulic balancing guarantees low load on the bearing. A single acting mechanical seal is provided for the drive screw.

Three-rotor screw pumps can handle liquids with good lubricating properties and flow rates up to 720 m<sup>3</sup>h at differential pressures up to 250 bar with viscosities ranging from 3 to 15,000 mm<sup>2</sup>/s.

The majority of three-rotor screw pumps in upstream applications are used for the lube oil supply on diesel or gas engines, turbines, compressors and large gear units. The pumps are either directly installed to the equipment or part of lube oil systems, such as in accordance with API 614. For crude oil with a low API gravity and differential pressures up to 130 bar, three-rotor screw pumps can also be employed as pipeline pumps or booster pumps. In these applications, screw pumps are often more cost effective than centrifugal pumps.

A variety of construction materials, including NACE compliant materials, is available for the pipeline pump range. The screws are usually surface hardened and a wear resistant coating for the liner can be provided. The units could be skid mounted with all required controls and driven by electric motors, gas or diesel engines.

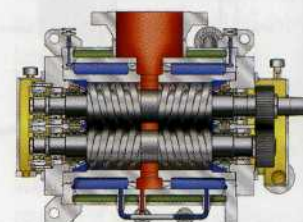


**Leistriz twin-gearscrew pump - LA Series**

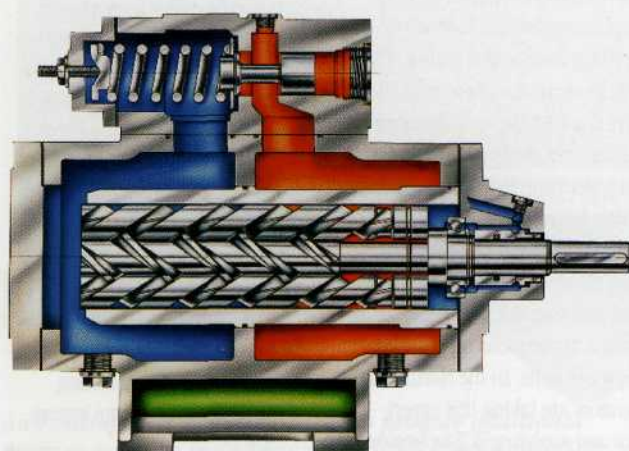
Three-rotor screw pumps have only a few moving parts which results in long service life and easy maintenance.

### Twin-Gear Screw Pumps

Twin-gear screw pumps are usually of double volute design. The flow splits after entering the pump suction and is pressurized within the screw packages with opposed helix, which are installed in a replaceable casing insert (liner). As a result of this design, the pump bearings are not exposed to axial forces. The torque from the drive screw is transmitted to the idler screw by oil lubricated timing gears. Both screws are not in contact with each other. This makes twin-gear screw pumps particularly suitable for handling non-



**Leistriz high-pressure multiphase pump**



**Leistriz three-rotor screw pump - L3 Series**



*Leistritz three-rotor screw pump with 55 bar  $\Delta p$  as pipeline pump in Egypt*

lubricating, contaminated and high viscous liquids (up to 100,000 mm<sup>2</sup>/s).

The pump casing is either casted or welded with an option for various port positions. The screws are cut from single piece bar stock for maximum stiffness and minimum shaft deflection under all operating conditions. Surface hardening increases the wear resistance of the screws. Drive shafts and idler shaft are sealed by unbalanced single acting mechanical seals as a standard. Double acting mechanical seals as well as mechanical seal arrangements following API 682 can be provided. Each screw is carried in heavy duty and lifetime optimised bearings.



*Pipeline start-up pump in Africa*



*Crude Oil Booster Pumps Type L4*

For upstream applications, twin-gear screw pumps are used as pipeline pumps for crude oil, as pipeline booster pumps, pipeline start-up pumps, produced water pumps or for gathering and transfer duties onshore, on offshore platforms or FPSO's. Flow rates up to 2,250 m<sup>3</sup>/h at differential pressures up to 100 bar can be handled.

The standard pump construction materials for oilfield applications are either cast carbon steel or welded carbon steel with surface hardened screws. Stainless steel options including Duplex and Superduplex as well as special alloys are available. For sour gas service, materials in accordance with the NACE requirements are selected. The units are usually skid mounted with all required controls and driven by electric motors or combustion engines. Where necessary, lube and/or seal oil systems are part of the packages.

### Multiphase Pumps

During the past 15 years, multiphase pumping has become an accepted technology among the global oil producers.

With decreasing oil reserves but an increasing oil price, multiphase pumps offer the possibility to

recover efficiently oil and gas from matured fields with low well pressure and increasing water cut and gas to oil ratio (GOR). Conventional equipment like separators, compressors, liquid pumps, heaters or individual flow lines are replaced by an economical multiphase pump unit which also boosts the well flow to a central treatment facility through only one pipeline. The vast elimination of flaring contributes to the growing environmental consciousness.

A small footprint and the low weight compared to conventional separation equipment makes multiphase pumps particularly suitable for the installation on offshore platforms.

Multiphase pumps are pumps which have been designed to handle oil, water and gas mixtures with gas fractions as high as 100 percent. They are based on the twin-gear screw pump technology, however, incorporate some special design features. Firstly, multiphase pumps are very compact. The bearing span is much shorter than for conventional twin-gear screw pumps in order to keep the shaft deflection as low as possible. This is particularly important for high pressure pumps. Both screws are carried in heavy duty roller bearing. As a result of the double volute design, the pump bearings are not exposed to axial forces. The screws are cut from single piece bar stock and have a large root diameter for optimized stiffness. The shafts are sealed by balanced mechanical seals. Double acting mechanical seal are recommended for applications with high gas volume fraction, high solid content or with the presence of sour gas (H<sub>2</sub>S).

The multiphase twin-gear screw pumps are available in a low pressure version up to approximately 30 bar (450 psi) differential pressure and in a high pressure execution for up to 100 bar (1,450 psi)



*Multiphase pump with external recirculation system*

differential pressure. Depending on the operating conditions, maximum flow rates up to 2,500 m<sup>3</sup>/h (377,650 bbl/d) can be achieved. The pump speed can be varied between 30 and 150 percent of the design speed.

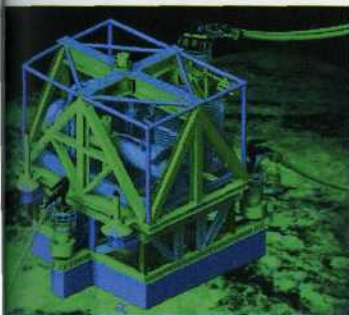
The gas volume fraction (GVF) handled by multiphase pumps can be as high as 100 percent. Where longer gas slugs are expected, external recirculation is provided. Such systems are located upstream the pump discharge and within the skid limits and provide constant liquid injection as an internal liquid seal between screws and liner during the compression of the gas phase.

The multiphase pumps are offered in a wide range of constructions materials. Beside the basic carbon steel versions, a variety of stainless steels or Duplex stainless steels can be supplied. For sour gas applications, NACE compliant materials are selected for all wetted pump components.



*Leistritz multiphase booster pump unit*

Most multiphase pump applications can be found in remote locations with difficult infrastructure. They are installed in deserts, jungles or in arctic climates. The installations are mostly unmanned and subject to remote control. Beside the pump and drive, motor driven block valves, strainers, relief valves, lube and/or seal oil systems with on-skid piping and wiring are provided. Extensive skid instrumentation permits monitoring of the actual operating conditions and protects the unit against failures.



### *SBMS-500 subsea multiphase pumping system*

Beside inverter driven electrical motors, gas or diesel engine driven pumps are used in areas with no power supply, such as in wellhead platforms.

An increasing field of application for multiphase twin-gear screw pumps is the subsea technology. A vast number of oil and gas reservoirs are located offshore at water depths of 1,000 m (3,280 ft) and more.

Based on a co-operative agreement between Petrobras, Curtiss-Wright (EMD) and Leistriz Pumpen GmbH, the SBMS-500 Subsea Multiphase Pumping System has been developed. After extensive testing at differential pressures in excess of 60 bar (870 psi), the system will be installed subsea in Brazilian waters at a depth beyond 500 m (1,640 ft) in the first half of 2006.

Increasing demands for higher flow rates and pressures have initiated research and development programs with the target to design new pump ranges for dry and sub-sea installations for differential pressures up to 150 bar (2,175 psi).

### **Leistriz Pumpen GmbH Joins Forces With Eptec AS**

Eptec AS became a part of the BjØrge Group in late 2004 and now belongs to BjØrge Products & Systems. The BjØrge Group is listed on the Oslo stock exchange. As one of the leading suppliers of pumps to the oil & gas, land based process and marine industries in Norway, Eptec has been a market player since the 1980's. Eptec provides service to its customers through the main pump engineering centre in Oslo and their service support centres in Moss and Stavanger during the complete life cycle of the pumps.

Eptec endeavours to offer more cost effective solutions by focusing on better pump performance. The goal is always to enhance the customer's value chain using our experienced people, high ethical standards, products and engineering capabilities. Contracts for the Ormen Lange project and major FPSO converters/builders have been recently secured.

With over 650 employees, BjØrge ASA delivers products and performs project and maintenance services for the oil and gas, land-based and marine industries. It is divided into two business areas - Products & Systems and Modifications & Maintenance Support. While the group's activities are mainly concentrated in Norway, export accounts for a substantial proportion of the sales of several of its companies.