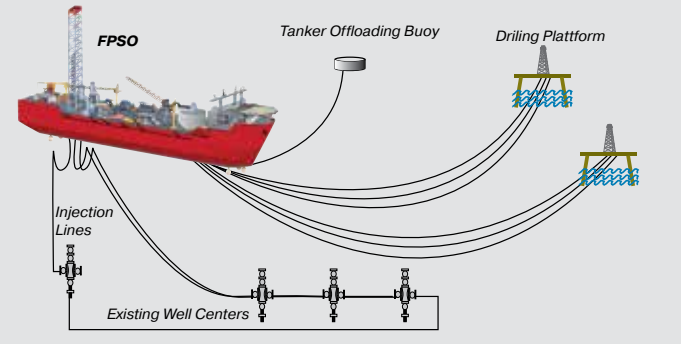
Multiple screw pumps of FPSO vessels

Floating production, storage and offloading vessels offer an economical and flexible alternative to further develop remote fields without pipeline connection to onshore treatment facilities

During the past five decades, the booming offshore activities of the oil and gas industry required new approaches to processing and transportation of the well streams from platforms and subsea fields.

Topsides

FPSO vessels are converted tankers or specially designed floating facilities which are divided in the topsides with modules for hydrocarbon processing equipment, storage facilities and the marine section. They are permanently moored to the seabed. FPSOs make it feasible to produce small oil fields and allow an easy relocation to another field. Flowlines and flexible risers connect drilling and wellhead platforms or subsea wells to the inlet manifold of the FPSO topsides. The well flow is boosted by single phase or multiphase pumps.



Typical FPSO arrangement with topside and subsea facilities

Twin screw double volute, self-priming positive displacement pumps are particularly suitable for this purpose. They can handle oil, produced water and gas at high flow rates and differential pressure. After entering the inlet manifold of the FPSO, the three phases are separated in the first stage separator.

The separated gas is released into a gas treatment unit, comprising a compressor for either reinjection into the wells (gas lift) or into an export pipeline. The produced water is handled in the produced water system and the crude oil is directed to the second stage separator with an electric dehydrating system, which is used to reduce the remaining water content of the export crude oil to 0.2% to 0.5%.

These twin screw positive displacement pumps serve as transfer and feed pumps within the system. The generally high chloride content of the produced water requires duplex stainless steel for the wetted pump parts.

The export crude oil is transferred from the electric dehydration system into the FPSO's own storage facilities by twin screw pumps or triple screw pumps. High volume twin screw pumps transfer the crude oil to shuttle tankers which serves refineries and storage terminals onshore.

The topside has modules for power generation with gas engines or turbines. Triple screw pumps are used as lube oil pumps on the lubrication systems. Similar systems are also installed on the gas compressors of the FPSO.

Typical FPSO

Marine Section

Twin, triple and five screw single volute, self-priming positive displacement pumps are used at various locations in the marine section of the FPSP vessel:

- As lube oil transfer pumps
- As main and pre-lube oil pumps for dry or submerged installation for the main engine and gear reducers
- As fuel oil transfer pumps
- As fuel oil feeder pumps
- As fuel oil booster pumps
- As boiler supply pumps
- As separator supply pumps
- As hydraulic pumps in hydraulic systems for hydraulic driven propellers, hydraulic motors, steering gears, etc.
- As hydraulic pumps for the gears of the winches used for anchors or mooring lines.

Vertical twin screw pump as crude oil export pump for FPSO

Rotary positive displacement screw pumps

The oil and gas and the marine industries offer a range applications to screw pumps. Screw pumps are rotary positive displacement pumps, which have certain advantages over other pump designs:

- The capability of handling liquids with low or very high viscosities
- High efficiencies, hence, low power requirements
- Low shear pumping of oil/water mixtures
- Pump flow rates almost independent of the back pressure
- Self-priming
- Smooth and almost pulsation-free operation with low noise level
- Capable of handling liquids with entrained gas
- Easy flow control by speed variation.

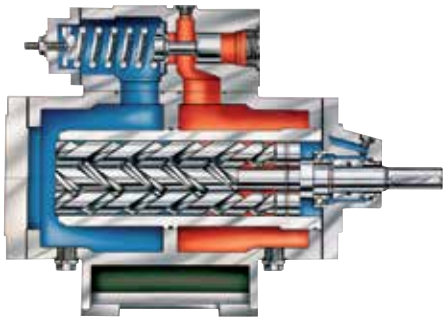
Three-rotor and five-rotor screw pumps

A set of three (five) screws is installed in a pump casing. The centre screw drives the idler screws which are located on either side resp. around the drive screw. The pumped product is carried in cavities formed between the 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 loads on the bearing. A mechanical seal seals the drive screw against the atmosphere.

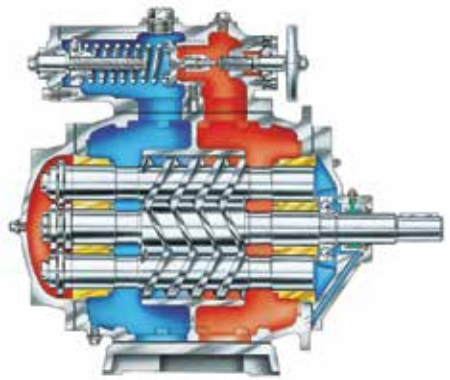
Three (five)-rotor screw pumps can handle liquids with good lubricating properties and flow rates up to 700m³ per hour at differential pressures up to 280bar and viscosities ranging from 1 to 15,000mm²/s.

The majority of three (five)-rotor screw pumps are used for the lube oil supply on combustion engines and other large rotating equipment. The pumps are either directly attached to the equipment or part of stand-alone lube oil systems, for example according to API 614.

For crude oil with a low API gravity and differential pressures up to 130bar, three-rotor screw pumps can also be employed as pipeline or transfer pumps.



Leistritz triple screw pump, L3 Series



Leistritz five screw pump, L5 Series

Twin screw and multiphase pumps

Twin screw pumps are of double volute design and 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 screw pumps particularly suited to handling non-lubricating, contaminated and high viscous liquids (up to 100,000mm²/s) or liquids containing gas.

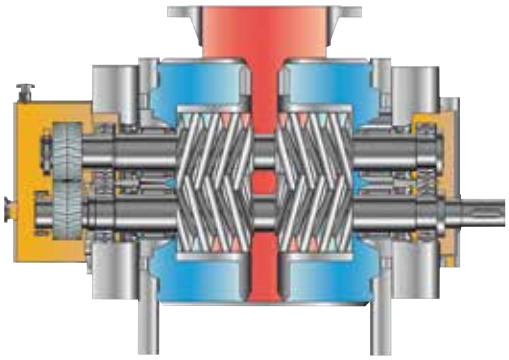
The pump casing is steel welded with an option for various port positions. For sour gas service, materials in accordance with the NACE requirements are selected. The screws are cut from single piece bar stock for maximum stiffness and minimum shaft deflection under all operating conditions. Surface hardening increases the wear resistance of the screws. Drive shafts and idler shaft are sealed by single or double acting mechanical seals. Each screw is carried in heavy duty and lifetime optimised bearings.

For upstream applications, twin screw pumps are used as pipeline pumps for crude oil, as pipeline booster pumps, produced water pumps or for gathering and transfer duties onshore, on offshore platforms or FPSOs. Flow rates up to 5,000m³ per hour (755,300 barrels per day) and differential pressures up to 150bar can be handled.

With decreasing oil reserves but an increasing oil price, multiphase pumps offer the possibility to efficiently recover oil and gas from matured fields with low pressure wells. Conventional equipment such as separators, compressors and individual flow lines is 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 make multiphase pumps particularly suitable for the installation on offshore platforms.

Multiphase pumps handle oil, water and gas mixtures with gas fractions as high as 100%. Where longer gas slugs are expected, external liquid management systems are 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.

Leistritz multiphase pump system



Leistritz twin screw pump, L4 Series

For more information:
www.leistritz.de