

## HJ4 Mechanical Seals

for High Pressure Crude Oil Pipeline Pumps

Information E09021

### Operation area

The Republic of Sudan is a country in north-eastern Africa with an access to the Red Sea. With an area of about 2,5 million square kilometers, it is the largest country in the African continent and the Arab World. It is seven times bigger than Germany. The Sudan has various mineral resources but currently oil is its main export, and production is increasing dramatically (38.1 % growth from 331,000 barrels per day (bpd) in 2006 to 457,000 bpd in 2007). The country has estimated reserves of 6.6 billion barrels of oil.

China, the world's second largest oil consumer, buys some of its oil from Sudan. In 1984 the Chinese began to explore oil in the African Continent, particularly in Sudan. Petro-Energy, China's largest oil company was granted an oil production license and has been investing in Sudanese oil fields since 1984.

Petro-Energy awarded 2004 a multi-million Euro contract to the German pump manufacturer, Bornemann Pumps GmbH, for several high-pressure pipeline pumps.

### Process and equipment

A 700 km pipeline runs from the oil fields near Baleela via Khartoum refinery where the high viscosity crude oil is processed and then forwarded through the pipeline to Port of Sudan for export to China.

Six pumping stations keep the crude oil flowing smoothly through the pipeline. High pressure twin screw pumps were commissioned at Pump Station I beginning 2004 and subsequently Petro-Energy decided to install similar pumps at stations III and IV. The following equipment is needed at each pump station:

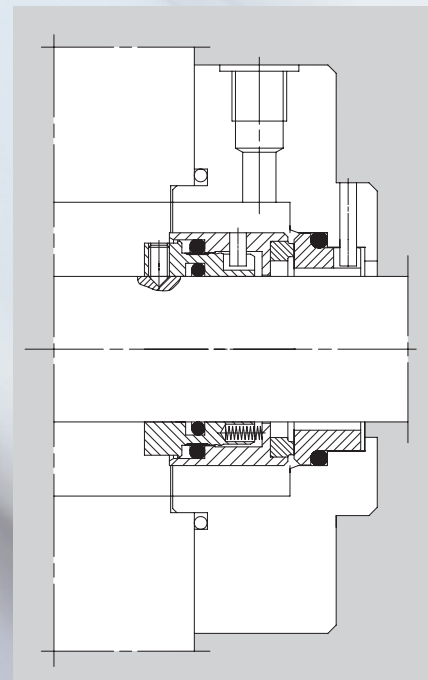


Bornemann high pressure crude oil pump in operation

- Three pumps, each driven by an eight cylinder diesel engine
- One cooling system for each diesel engine and pump
- One automatic control unit per pump
- One compressor per pump station to start the engines

### Challenging conditions

Considerable expertise was involved in the design of the diesel engines and systems which have to operate at ambient temperatures up to 58 °C at an altitude of 686 meters above sea level. Components must be designed to compensate for losses which occur as a result of climatic conditions to ensure that performance. The pumps transport 16,000 to 30,000 barrels a day (bpd) at differential pressures of up to 97 bar.



EagleBurgmann HJ47GS1 Mechanical Seal

Each twin screw pump has two rotating shafts with two seals per shaft; thus four mechanical seals are installed in each pump. The sealing solution had to manage some very challenging conditions:

- Medium: crude oil
- Viscosity: 990 ... 1,700 mm<sup>2</sup>/s
- Suction pressure: 4 ... 50 bar
- Temperature: 29 ... 70°C
- Speed: 440 ... 1,240 min<sup>-1</sup>

### The EagleBurgmann HJ4 seals solution

Our seals have been selected for this very demanding application. Single HJ47 series seals are installed on all of the pumps:

- HJ47GS1/35-G16
- HJ47GS1/90-G9
- HJ47GS2/30-G16
- HJ47GS3/60-G16
- HJ47GS3/120-00

A total of 300 seals in five different sizes have been supplied. The rugged HJ component mechanical seals are balanced and have multiple springs. As the outboard springs do not come into contact with the product, no clogging occurs. Large clearances between the seal rotor and stator enhance drainage of high-viscosity leakage. The rotating seal face has a smooth process side contour and mates with a stationary seat.

The material combination Q3Q2VGG1 was selected. The face material pairing is Buka 30 vs. Buka 20. The secondary seals are made of Viton®. 1.4571 is used for the springs, and all other parts are made of 1.4462. A chrome oxide coating is applied to the metal component in the area of the dynamic O-ring.

### Successful installation and performance

Three flights from Frankfurt-Hahn Airport in Germany were needed to transport the pumps, engines, etc. to Khartoum. The Chinese customer took possession of the systems in Khartoum and transported them by heavy vehicle to the final destinations. Teams sent out by the pump manufacturers kept an eye on the installation work and provided on-site training. The pumps have now been in operation for five years. There is currently no other comparable screw pump installation anywhere in the world. Despite the adverse conditions, there have been no problems on the project. Seals and pumps mastered the difficult startup conditions and showed an outstanding sealing performance.



A typical HJ seal with shrunk-in sliding face