

Case Study

Hydrokraft® Piston Pumps

Our pumps help **increase efficiency** of the **world's largest diesel engines**

Location:

Copenhagen, Denmark

Segment:

Offshore and marine

Challenge:

Supplying pumps that offer nonstop 48,000-hour performance, clockwise and counterclockwise operation at maximum efficiency, and capability to prevent cavitations

Solution:

Hydrokraft® piston pumps

Results:

Hydrokraft pumps are at sea on container vessels made by South Korean shipbuilders and are being sold to the aftermarket

Background

Some of the world's largest container vessels are using less fuel and reducing their carbon footprint, thanks to Danfoss' expertise in providing efficient hydraulic power at sea.

MAN Energy Solutions of Copenhagen, Denmark, and its licensees, are relying on Vickers by Danfoss Hydrokraft axial piston pumps to provide the hydraulics muscle for MAN's marine diesel engines that propel oceangoing vessels operating all over the world. The massive engines are up to 25 m (84 ft) and 15 m (50 ft) high, weigh in at a whopping 2,300 tons, and deliver close to 100,000 horsepower!

Each two-stroke engine is equipped with five Hydrokraft pumps made at Danfoss' Wehrheim, Germany facility.

Challenges

With 75% market share in marine diesel-engine design, MAN Energy Solutions approached Danfoss with pump requirements for its revolutionary 12K98ME "Intelligent Engines" that operate without a camshaft. Danfoss engineers learned that MAN Energy Solutions needed piston pumps to take over the duties of the camshaft at the heart of the engine's electrohydraulic system.

Engineers at MAN Energy Solutions explained that the green engine needed high-performing pumps that would control fuel injection and exhaust valve actuation that otherwise would be controlled by mechanical components. By providing continuously variable fuel injection and valve timing via high-performing pumps, the camshaftless design has unlimited flexibility, which enables the Intelligent Engine to reduce fuel consumption and emissions.

Because the OEM designs its engines to run around the clock for up to five years, it required pumps that would operate reliably for more than 48,000 hours at full ratings. "If the pumps fail, the vessel shuts down," stated a Danfoss engineer—Hydrokraft products, "so MAN Energy Solutions needed assurance that Danfoss pumps would provide trouble-free, non-stop service."

Another challenge was the propeller of oceangoing vessels is directly connected to the engine's crankshaft. This means that when a ship is running astern, the direction of engine rotation needs to be reversed.

Challenges

Since our pumps are driven by the engine's crankshaft, they had to be capable of operating clockwise and counterclockwise for mooring, which was a considerable challenge for open-circuit pumps. Also the requirement to change rotation direction, another challenge presented itself. Cavitations had to be prevented, which could occur due to pulling effects of the adjacent oil volume.

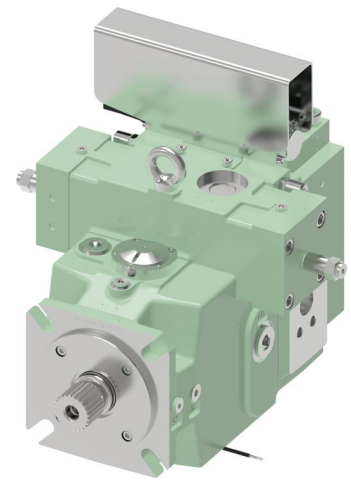
Solution

Danfoss' Hydrokraft PVWS-500 pumps with 500 cc/rev displacement and maximum operating pressure of 350 bar were selected for the application. Their heavy-duty design and maximum efficiency ensure a 48,000-hour service life while operating at full ratings for most of the duration.

Danfoss collaborated with the University of Dresden to design a custom valve plate that would enable the Hydrokraft pumps to run counterclockwise as well as clockwise. Thanks to the university's engineering support and exhaustive testing, the pumps operate in two quadrants with increased efficiency, even while running in an open circuit. By implementing an additional check-valve block, cavitations were prevented by creating a shortcut to the pump inlet before outlet pressure is too low.

Results

MAN Energy Solutions sells engine-build licenses to ship and engine builders worldwide. To date, Danfoss pumps are at sea on container vessels made by Hyundai Heavy Industries and Doosan Engine, both of South Korea.



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