

Royal Danish Navy Commissions LM500 Test Cell

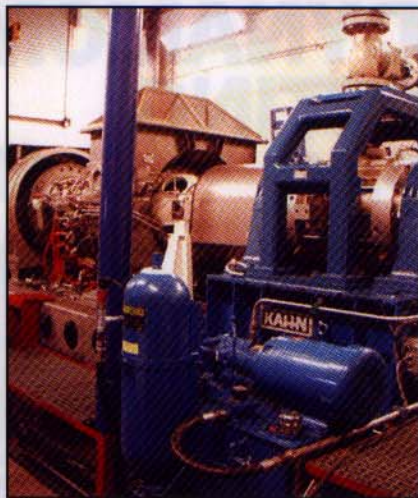
To maintain the combat readiness of its most versatile combatant ship, the Royal Danish Navy recently commissioned a test cell for performance testing of General Electric LM500 marine gas turbines at its Korsøer Naval Base.

With 14 ships in service, the Standard Flex 300, or *Flyvefisken Class*, represents the numerically largest class of ships in the Danish Navy. Because of their multi-role design concept, these ships can be configured for a variety of missions, including surveillance, combat, mine laying, mine countermeasures and anti-submarine warfare.

To meet the Navy's requirements for speed and economy, the Standard Flex 300 is equipped with a CODAG power plant, consisting of two MTU diesels and one GE LM 500 rated 4500 kW. The LM500 drives a fixed pitch center propeller through a speed reducing gearbox, while the MTU diesels each drive a variable pitch wing propeller. Derived from the high efficiency TF34 turbofan engine, the LM500 is GE's smallest aeroderivative marine gas turbine.

The new LM500 test cell at Korsøer will enable the Danish Navy to perform diagnostic test procedures and verify the performance of the gas turbines after overhaul. This is the first and only test cell in the world built specifically for testing LM500 marine gas turbines. A typical post-overhaul performance test of the LM500 includes operation at partial loads and full power and requires approximately four hours. During the test, more than 35 engine operating parameters are measured and recorded at each operating point.

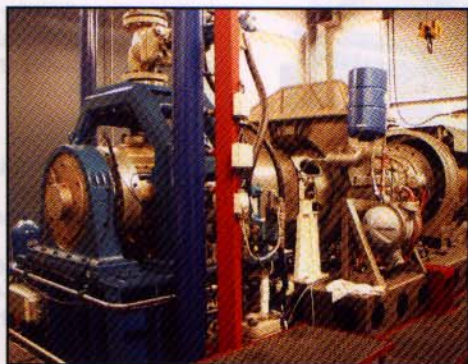
The key element of the new test cell is a Kahn model 108-130 hydraulic dynamometer. Capable of absorbing 12 000 kW at rotational speeds up to 10 000 r/min, the dynamometer is directly coupled to the LM500. Using water as the operating medium, it absorbs and measures the power output of the gas turbine.



A Kahn model 108-130 hydraulic dynamometer, capable of absorbing 12 000 kW at speeds up to 10 000 r/min, is the key element of the Royal Danish Navy's new LM500 engine test cell.

In this particular application, a water flow rate of 136 m³/h allows conversion of mechanical energy from the turbine into heat. While operating at the maximum power level of the turbine, the water temperature rise across the dynamometer is 28°C.

Developed for performance testing of industrial and marine gas turbines, the Kahn Series 100 line of hydraulic dynamometers includes eight standard models with power outputs ranging from 4800 to 60 000 kW. With over 25 units in service, the Series 100 are the most widely used high-speed, high-power dynamometers in the world, according to the Wethersfield, Connecticut, U.S.A., company. A compact design and proven reliability have made the Series 100 the choice of many of the world's leading gas turbine manufacturers, research organizations, and turbine overhaul facilities,



The Royal Danish Navy recently commissioned an LM500 engine test cell at its Korsøer Naval Base. The LM500 aeroderivative gas turbine is part of the CODAG power plant that powers the Navy's Standard Flex 300 multirole ships.

including ABB Alstom, Argentine Navy, Dresser-Rand, General Electric, ITP, Kawasaki Heavy Industries, Mitsubishi Heavy Industries, NASA, GE Nuovo Pignone, Pratt & Whitney, Rolls-Royce, Royal Danish Navy, SNECMA, U.S. Navy, and Volvo.

The ability to provide highly stable operation and accurate and reliable turbine performance data was a primary consideration in the selection of the dynamometer equipment. To meet this requirement, Kahn supplied its Series 535 closed-loop control system along with the dynamometer. Developed specifically for steady state and dynamic testing of gas turbines, the Series 535 includes a fast response microprocessor-based PID controller and high-performance electro-hydraulic control valves. The system features an overall controller loop time of 12 ms and a valve frequency response in excess of 45 Hz. During initial performance tests when the dynamometer was operating in the speed control mode, the Series 535 provided precise steady state speed control within ± 1 r/min.

Another important requirement of the Danish Navy was the capability of the dynamometer to provide quick, safe emergency shutdowns. Equipped with mechanical carbon face seals, the model 108-130 provides positive sealing between the water and bearing compartments under all operating conditions, including zero speed. This feature is particularly useful during emergency shutdowns, where it is critical to reduce speed quickly by applying full load until the turbine reaches zero speed.

To reduce setup time for future turbine test applications, the Royal Danish Navy also required that the dynamometer could be driven in either direction of rotation from either end of the shaft without the need for repositioning of the equipment. Bidirectional operation is a standard feature of Kahn's Series 100 dynamometers. It eliminates complicated setup and alignment procedures associated with unidirectional dynamometers.

The new facility will serve as an important quality assurance tool which will enable the Navy to diagnose the conditions of its engines and to verify their performance after overhaul under actual operating conditions. 