Tapping in to shaft torque

Permanent torque and power measurement on the propeller shaft yields valuable information helping to prevent main engines and reduction gearsets becoming over-stressed

Torque measurement and analysis contributes to optimising a ship's operational parameters, such as maintaining or increasing speed with reduced fuel consumption through optimum trim and/or optimum propeller pitch. It can also synchronise load distribution on twin-shaft vessels, aid evaluation of overloads, identify the true cause of expensive failures, verify performance specifications and quantify system improvements.

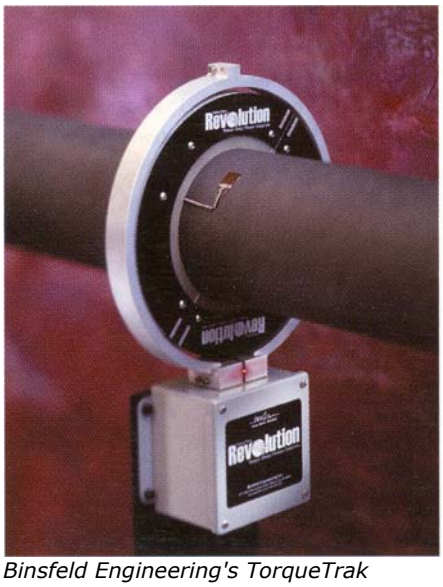
Laser technology and fibre optic signal transmission have eliminated the weaknesses of traditional strain gauge-based systems in measuring shaft torque and power, asserts **MetaSystems AS.** The Norwegian electronics specialist's fully digital MetaPower system exploits a concept whereby the relative position between two coding wheels mounted on the shaft is measured by a pulse-modulated infrared laser beam transmitted via fibre optic cables to a single light sensor.

High accuracy and very good long-term stability are claimed for the system, which has no mechanical parts subject to wear and tear, and is insensitive to electrical fields and ambient temperature variations. Furthermore, since MetaPower is unaffected by centrifugal forces it is reportedly ideal for shafts running at very high rpm.

MetaPower was developed to measure and calculate:

- the torsional angle between two cuts of the shaft (that is, the torque)
- rpm
- the power transferred by the shaft
- average power and accumulated energy over a selected period
- total accumulated energy since commissioning.

Optional software is offered for torsional oscillation analysis. By measuring, recording and analysing torque oscillations, the system can detect faulty operational propulsion conditions and provide corrective actions and preventative maintenance at the right time, says MetaSystems. Measured values can be presented in three ways: a graph showing torque as a function of time; a graph showing torque as a function of the rotational angle ;and a corresponding torsional oscillation frequency spectrum.



Binsfeld Engineering's TorqueTrak Revolution system

Analysis may be performed in real time (on line) or on recorded files of data. Data logging can be carried out on one shaft or two shafts simultaneously in three different modes: continuous logging (recording the shaft continuously); interval logging (recording the shaft for a short period at selected intervals); and overload logging (recording the shaft when torque and/or power exceed pre-set levels).

In addition to carrying out measurements and analyses on the fixed part of a shaft, the MetaPower system can measure the torsional angle and analyse angular oscillations across flexible couplings.

Measured values can be displayed on analogue instruments, the ship's computer network or integrated monitoring and control system, on an LCD monitor in digital form, or on a standard PC monitor in both analogue and digital forms.

Two systems from **Binsfeld Engineering Inc** are designed to measure torque on rotating shafts without machine disassembly or shaft modification. The Michigan, USAbased company specialises in transmitting sensor signals from rotating machinery and has designed non-contact data transmission systems since 1974.

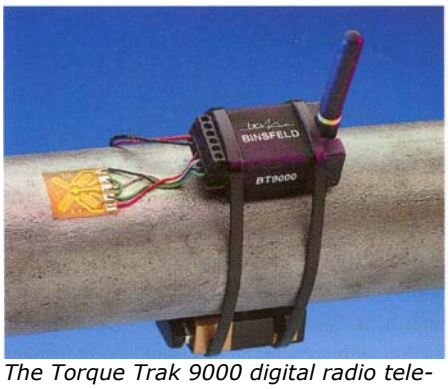
Designed for short term diagnostic measurements, TorqueTrak 9000 is a digital radio telemetry system which converts virtually any shaft into a rotating torque sensor. The miniature battery-powered transmitter rides on the shaft and broadcasts digital data from a torque-sensitive strain gauge, providing real time information during running.

Accuracy and stability are claimed for the system, which features seven user-selectable gain settings and eight user-selectable broadcast frequencies, and auto-zero and low battery indicator functions.

Permanent real time monitoring of four parameters - torque, speed, power and direction of rotation - is offered by Binsfeld's Torque Trak Revolution, the equipment fitting any size of shaft up to 20-inch diameter. The non-contact system uses inductive power and data transfer to eliminate mechanical wear surfaces, fostering long term reliable operation and noise-free data. A l4-bit microprocessor-based design contributes to high accuracy and resolution.

Hamburg-based **Hoppe Bordmesstechnik** highlights the ability of its torque power meter systems to protect engines from overload, optimise maintenance and enhance fuel economy. Over 1,000 installations are reportedly in continuous-duty service on all types of ships.

Two different Hoppe torque measurement systems are available, both measuring the propulsion shaft torsion; the effective power is then calculated from torsion and rpm. The traditional gear-type system measures torsion and speed via two pulse transmitters driven by shaft-mounted split tooth wheels. The angular offset between the two pulses forms a solid base signal for the torsional calculation.



The Torque Trak 9000 digital radio telemetry system from Binsfeld Engineering

In Hoppe's second system, the propulsion shaft torsion is measured by strain gauges. The signals arc wireless-transmitted to a static telemetric receiver where they are amplified and sent together with the speed signal for further analysis and data processing to an LM MIP unit. The latter analyses the signals from the torsion and rpm transducers and calculates torque and power. All the data can be selected on a four-line digital display.

Source: Marine Propulsion I December/January 2004/5