News

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MANNER® SENSORTELEMETRIE

High-Speed Torque Flange Sensors E-Mobility and Aviation

In the field of aviation as well as for the development of e-mobility, test benches with high speeds of up to 55,000 -1/min are necessary. In contrast to combustion engines, the speeds of electric motors are significantly higher.

The automotive industry has never come into contact with such high speeds before, which is why we are moving into uncharted technical territory here. Well known and well researched are such high speeds in aviation for turbine manufacturers. The classic test bench concepts of the automotive industry with their modular design and the associated component approach are no longer sufficient. Test bench concepts for the electromobility of the future must be newly developed with this background.

As a long-standing partner of the aerospace and especially the turbine industry, MANNER Sensortelemetrie has a lot of experience in the production of such transducers.

To design such high speeds, the entire drive train must be considered in terms of vibration. The natural frequencies of the individual components play a decisive role in the overall stability of the shaft train. Torsional "soft parts" such as couplings for decoupling parasitic forces like bending moment, lateral forces and axial force are extremely critical at high speeds.

These parasitic forces not only affect the drive technology, but also its measurement technology. In order to avoid the classic flanged couplings, measuring shafts with specially designed toothed connections are being used more and more frequently. Furthermore, such measuring sensors can be integrated advantageously into test bench transmissions.

Of course, high-precision torque measurement to determine the efficiency is also of central importance here. However, conventional concepts for torque measurement are no longer sufficient. The required high resonant frequencies of the drive train, low crosstalk of parasitic forces to the torque measurement and high radial forces require novel designs of torque transducers and their integration into the shaft train. For this task, design criteria such as those for turbo machines or turbine test benches must be applied.

Additional demands for lubrication of plain bearings often require hollow shaft designs. The lubricant is often transported in the bores. The required temperature resistance is also significantly higher than the previously usual +85°C. In climatic test rigs, the temperature range covers -40 to +160°C. Due to the integrated implementation an adapted design is often indispensable. The robustness of the measuring equipment is of particular importance.

MANNER has built up a great deal of know-how over the last 18 years through continuous development in the design and realization of special transducers for turbine and turbocharger test benches. The competence ranges from the mechanical design to the highly accurate measurement of torque and speed - even at high ambient temperatures of up to +160°C - as well as the corresponding contactless transmission technology, sensor telemetry.

A special challenge for test benches for electric motors is the increased and constantly changing ambient temperature. As is well known, the modulus of elasticity of a measuring body changes with approx. 2.5% above the temperature, which is significant. Furthermore, at these speeds there is a speed-dependent error of the zero point.

To meet these challenges, the MANNER High-Speed transducer is temperature and speed compensated and can deliver consistent and high accuracy over the entire operating range.

The quality of the transducer is verified by means of an air-conditioned calibration stand, which operates at ambient temperatures of -40 to +160°C. Corresponding speed test devices ensure the speed independence of the measuring sensor.

The recorded torque is already digitized in the rotor. The measured values are transmitted digitally and contactless to the signal pick up. The compensation is achieved by an integrated signal processor in the evaluation unit. This processor converts the raw values of the measuring body into the corrected values in real time. The parallel recorded measuring body temperature and the speed serve as a basis. In modern test bench concepts, the recorded data is usually transferred digitally via EtherCAT, CAN or Ethernet to the test bench data acquisition system.

The series includes all versions

- 50 N·m
- 200 N·m
- 500 N·m
- 1 kN·m
- 2 kN·m

and is available in the following standard speed versions:

- 27.000 min-1
- 55.000 min-1

Figure 1 and 2: High-Speed Torque Flange with pick-up

In addition, the hollow shaft option allows for complex test bench concepts, which means that oil supply in the center or actuators is not a problem. This is becoming increasingly relevant for e-mobility test benches.

Optionally MANNER is open for customer-specific flange geometries with individual connection. This can be decisive for the shaft dynamics. Due to their high temperature resistance, even solutions in high-reduction gearboxes can be implemented.

The high-precision torque acquisition for new e-mobility test bench concepts has the following characteristics:

- Design with decoupling of parasitic forces like bending moment, lateral forces and axial force
- Accuracy classes of up to 0.05
- Temperature range -45 to +160°C
- Maintaining accuracy over the entire temperature range through electronic compensation
- Integrated speed measurement
- Oil resistant
- Data output: Analog or EtherCAT, CAN and Ethernet possible

Figure 3: MANNER HS-Torque with pick-up and tube evaluation unit for installation in the control cabinet

If you have any questions or queries, please contact us by e-mail info@sensortelemetrie.de or by phone at +49 7424 9329-0.

MANNER Sensortelemetrie GmbH
Eschenwasen 20
78549 Spaichingen

Tel.: +49 7424 93 29-0
Fax: +49 7424 93 29-29
info@sensortelemetrie.de
www.sensortelemetrie.de