

## COMBINED CALIBRATION IN FORCE AND TORQUE

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*Abstract: A combination of both quantities force and torque together are often necessary. Some examples are given in testing ship propellers, or in case of fixing screws. Also in elastic axle bearings both quantities are working and both should be measured while happened together. The measurement equipment in the test rigs should be traceable. Therefore a transfer measurement equipment is needed which is calibrated by similar procedure as it is used.*

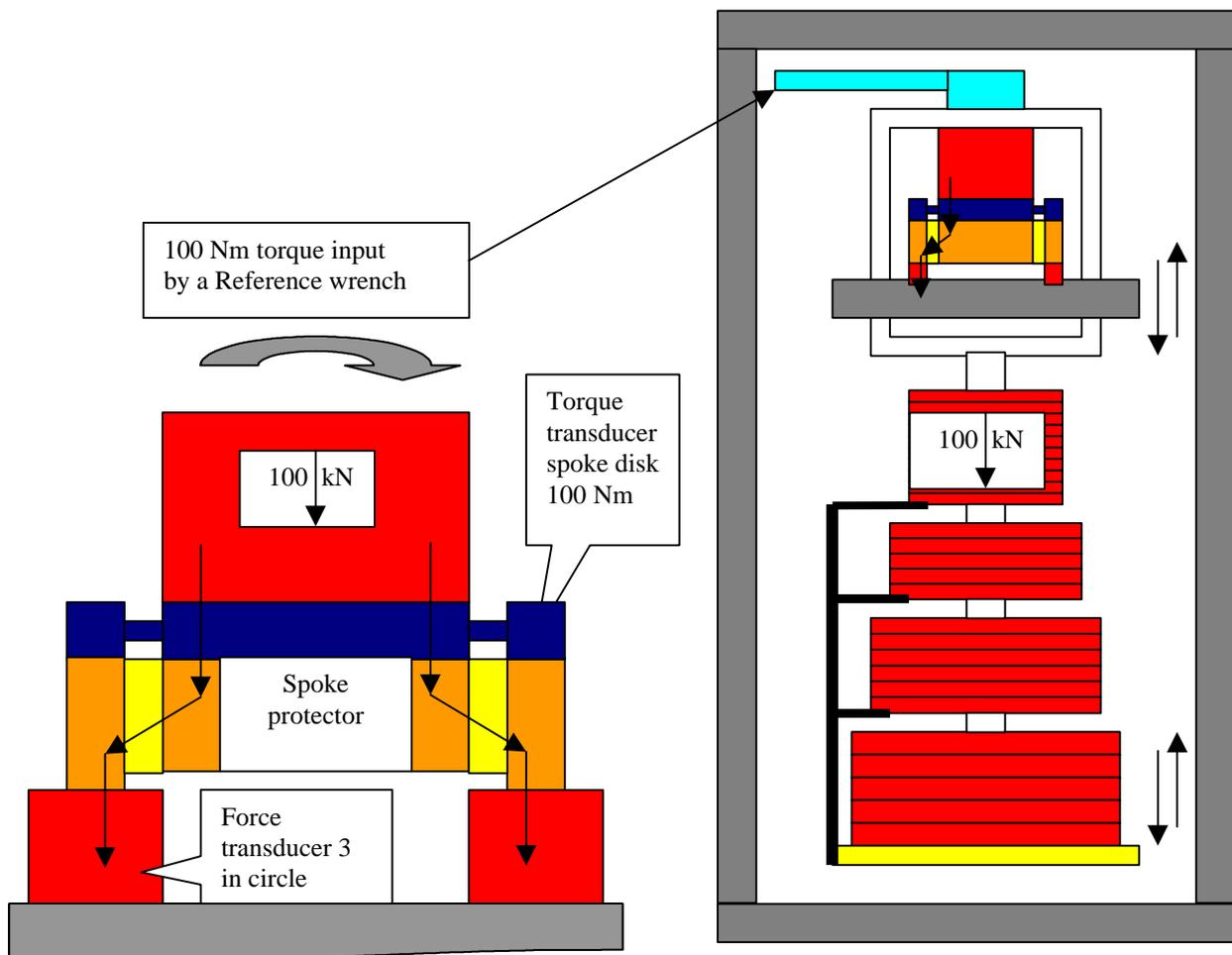
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### 1 INTRODUCTION

Transfer transducers are given in both single quantities torque and force. To combine torque and force, each of them should be absolutely insensitive to their partners influence.

### 2 TORQUE AND FORCE IN ONE CALIBRATION SYSTEM

To measure the influence from force to torque a following figure 1 shows a 100 Nm torque transducer while loaded by 100 kN.



**Figure 1.** 100 Nm torque transducer while loaded by 100 kN

### 3 TORQUE TRANSDUCER INSENSITIVE TO AXIAL FORCE

A 100 Nm Torque transducer disk figure 2 with a well known shear beam principle is supported by a spoke protector. This spoke protector figure 3 is calculated for low torsional rigidity and high axial stiffness.



**Figure 2.** Torque transducer disk



**Figure 3** Spoke protector

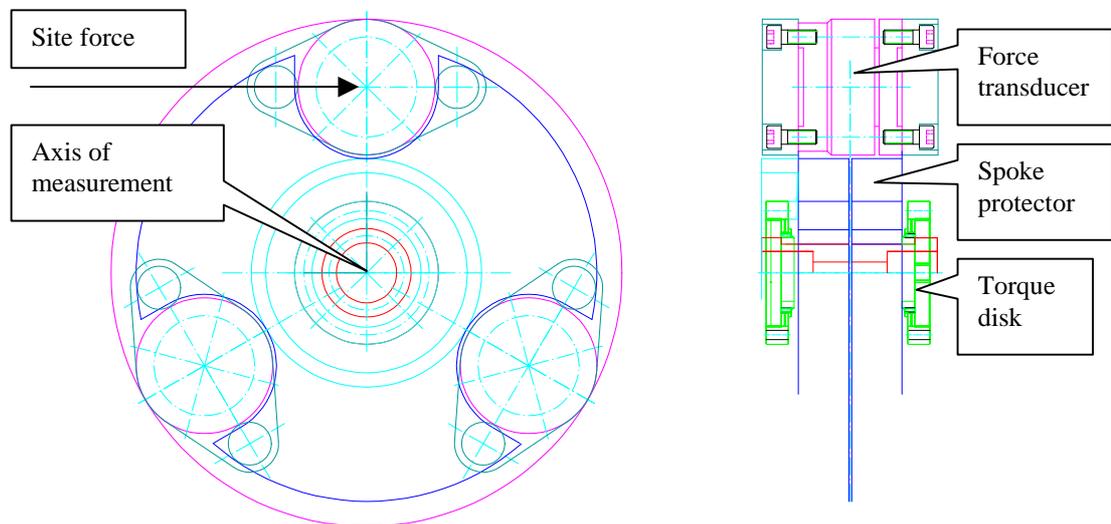
The torque zero signal in case of step by step loaded force is shown in the following table 1. A parallel torque is planned as it is shown in figure 1. Therefore a reference wrench 100Nm should be used.

**Table 1.** Zero signal in quantity torque by loaded force.

Torque Transducer TB1 S 100 Nm = 2.000 mV/V # 964430007			
Force (kN)	Torque in mV/V 1. serie pos. 0°	Torque in mV/V 2. serie pos. 90°	Torque in mV/V 3. serie pos. 0°
0	0	0	0
10	0,000642	0,000308	0,000293
20	0,000972	0,000526	0,000528
30	0,001298	0,000767	0,000776
40	0,001603	0,001025	0,001041
50	0,001907	0,001301	0,001324
60	0,002216	0,001603	0,001628
70	0,002515	0,001912	0,001941
80	0,002805	0,002650	0,002302
90	0,003076	0,002273	0,002678
100	0,003364	0,003043	0,003078
0	0,000003	0,000032	0,000017

#### 4 FORCE TRANSDUCER INSENSITIVE TO TORQUE OR SITE FORCE

The used 3 force transducers (figure 1) are positioned in a equilateral triangle. They been loaded by a site force as a result of the loaded torque. The force transducer position on a radius of 100 mm produced a peripheral force in summary of 1000 N. The used 50kN force transducers are 100% resistant to site force. So there is nearly no influence to the force signal. Figure 4 shows a draft of the positioning force transducers.

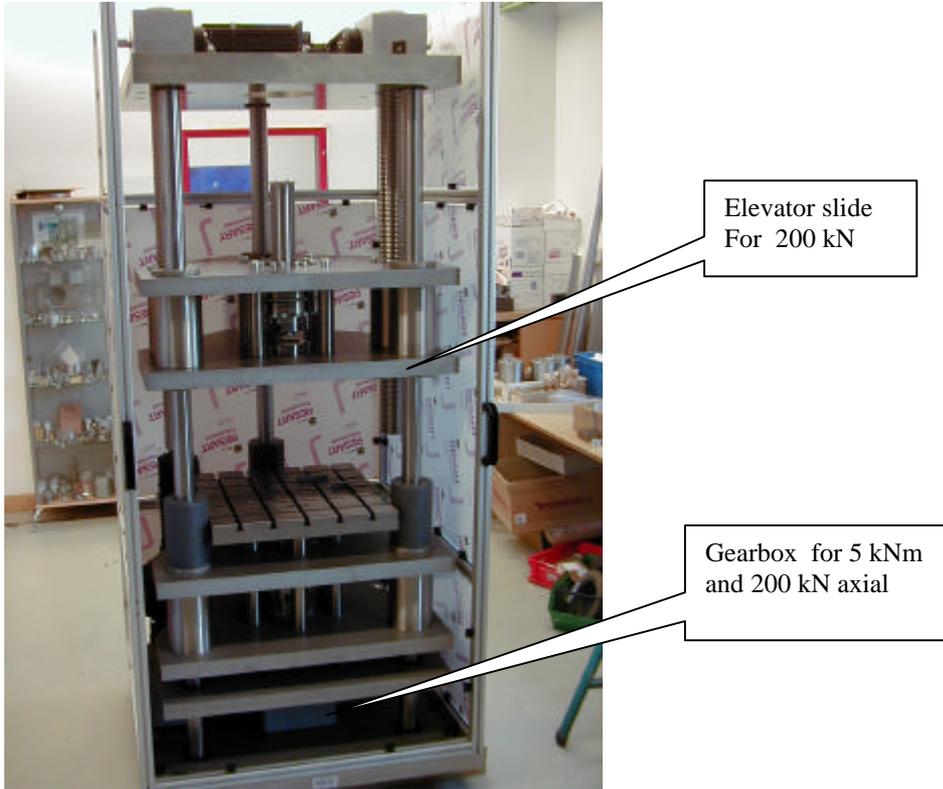


**Figure 4.** A combination of torque and force as a reference for testing screws or used a reference

The purpose of such a combined measurement equipment is a transfer to calibrate test units for screws and similar test stands as it is described on the top.

## 5 A REFERENCE CALIBRATION UNIT IN COMBINE 200 kN FORCE AND 5 kNm TORQUE

To do the calibration much easier than in figure 1, a reference system is much more flexible and faster. The condition in accuracy of Reference transducers should be min. 0.2%. The figure 5 shows a test rig with combine calibration possibilities.



**Figure 5.** Basic frame for a reference calibration system combine force and torque

A reference as it was shown in figure 1 could take place in such calibration system. Otherwise it could be used as a transfer to compare test stands, for screws and other similar products.

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