

Systematic errors in friction measurements

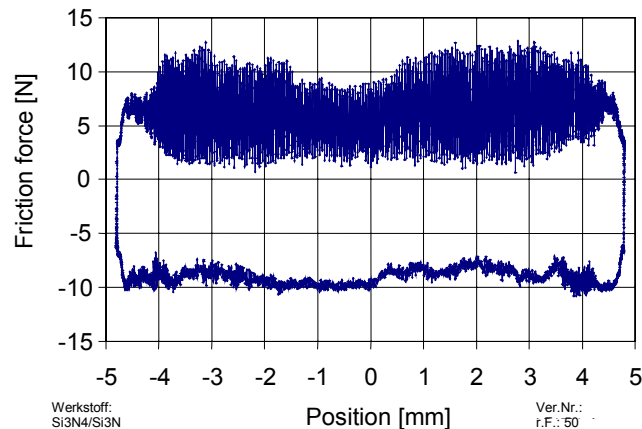
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Design engineers prefer friction numbers for their construction work. But already 1963 the FEYNMAN lectures on physics state: *The tables that list purported values of the friction coefficient of "steel on steel" or "copper on copper" and the like, are all false, because they ignore the factors which really determine μ .* A solution of this problem is that we analyse the friction behaviour carefully and comprehensively and publish not only some final numbers for friction coefficients, but also the complete set of parameters under which the respective experiments were performed.

For that purpose we must be aware of all factors influencing friction measurements, resulting from the equipment used and from the sliding system itself. However, we cannot eliminate the stochastic character of friction, but we can avoid the measurement and interpretation mistakes caused by that.

Typical examples of equipment induced measurement errors are presented. They are due to the mechanical construction, the signal processing and storing of data. Fig.1



shows the influence of the mechanical construction of tribometer on the stick/slip behaviour of a ceramic couple.

Other construction related sources of measurement errors are caused by the force sensors.

Fig. 1: Friction of $\text{Si}_3\text{N}_4/\text{Si}_3\text{N}_4$ for reciprocating sliding with stick/slip in one direction of movement

A large number of misleading friction values is due to not correctly controlled parameters or changes of parameters during the test of the tribo-system itself. Examples are humidity, contact pressure, vibrations, and with high importance the development and behaviour of wear particles.

Unidentified microscopic differences of the contact topography can also be a reason for differing friction values.

In micro-tribological friction measurements the influences of these hard to control parameters can lead to dramatically misleading interpretations of the respective experiments. For example the friction dependence on humidity can lead to completely wrong topography information, if measured with an AFM on an etched Si-surface.

Sometimes friction seems to be of stochastic nature.