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Friction of threaded fasteners

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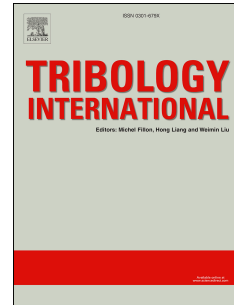
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Abstract

Complex tribological phenomena, which take place at the interfaces of threaded fasteners, cause that the torque value during tightening process is variable and submitted to various interpretation. In the following study one of the fundamental problems in threaded connections related to metrology of real accurate performances is presented and discussed as well as correct prediction, particularly the clamping force when torque control measurements are imposed. The systematic tribological investigations were carried out according to ISO 16047 assembly description and DIN 933 standard for threaded fasteners. Morphologies of threaded connections concerned the frictional process during fastening were also taken into the consideration, and analyzed before and after each cycle of tribological investigations. The observed and measured results are elucidated and commented. Based on scientific-examination of morphological analysis in the context of EUR 15178N prescriptions of the selected properly roughness 3D parameters in correlation with tribological ISO standards investigations are discussed. Measured modifications of surfaces morphologies of threaded fasteners components were stated and significant results are analyzed, elucidated, and statistically described in the present paper. The influence of manufacturing process and therefore of the surface morphology on the tribological aspects are essentially examined.

Keywords: tribology, surface morphology, threaded fasteners, bolt, nut, washer

Nomenclature

S_q	Standard deviation of roughness height distribution [μm]
D_b	Diameter of bearing surface under bolt head [mm]
d_2	Basic pitch diameter of thread [mm]
d_h	Clearance hole diameter of washer [mm]
\vec{F}	Clamping force [N]
P	Thread pitch [mm]
\vec{T}	Total torque [Nm]
\vec{T}_b	Bearing surface friction torque [Nm]
\vec{T}_{Th}	Thread torque [Nm]
μ_b	Coefficient of friction between bearing surfaces under bolt head [dimensionless]
μ_{th}	Coefficient of friction between threads [dimensionless]
μ_{tot}	Coefficient of total friction [dimensionless]
ω	Angular velocity [rad/s]
S_a	Arithmetic mean height, mean surface roughness [μm]
S_{ku}	Kurtosis of the surface height distribution
S_p	Maximum peak height, between the highest peak and mean line [μm]

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