Measurement of Load – Slip Forces between the Cital Spacers

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Spacer assembly and measuring tool has been designed and manufactured for the measurement (Fig.1). Torque wrench with 25 – 250 lb·inch was used for providing of a pressing force between the spacers. The spacer assembly was placed in the measuring tool and the middle spacer is moving by the pressing screw through the steel adapter. The load – slip force is defined as the minimal force corresponds to beginning of the middle spacer moving. Dial torque wrench with 0 – 75 lb.·inch was used for the load – slip force. Dial indicator measures the shift of the middle spacer.

The pressing force F is defined as [1]
$F = M/ (l/2\pi + r \cdot f \cdot \sec(c))$;
M – momentum of torque wrench, l – pitch of the thread, r – mean radius of the thread, f – friction coefficient, $c = 30°$ – half the angle between the faces of the thread. According to [1] the friction coefficient f is (with mineral oil lubrication) 0.10 for high-grade materials and workmanship, 0.12 for average quality materials and workmanship, and 0.15 for poor workmanship. Value of 0.12 was used for the F calculation. Screw with diameter 3/4" (pitch is 1/10") was used for the spacers pressing, and with diameter 1/2" (pitch is 1/20") for moving of the middle spacer.

The value of pressing force F is defined on 70 – 80 % by the friction forces therefore the measured value of F has error about 20 – 30 %.

Results of the measurement are shown in Fig.2. Data “without lubrication” were done without the teflon washer (1mm) and with lubrication of the threads only. Data “with lubrication” were done with lubrication of the threads and surfaces of the all washers and nuts.

Reference:

1. Marks’ Standard Handbook for Mechanical Engineers, Ninth Edition, Editors E.A. Avallone and T. Baumeister III, p.3-30