Appendix to Assignment 7

Temperature-dependant Overclosure:

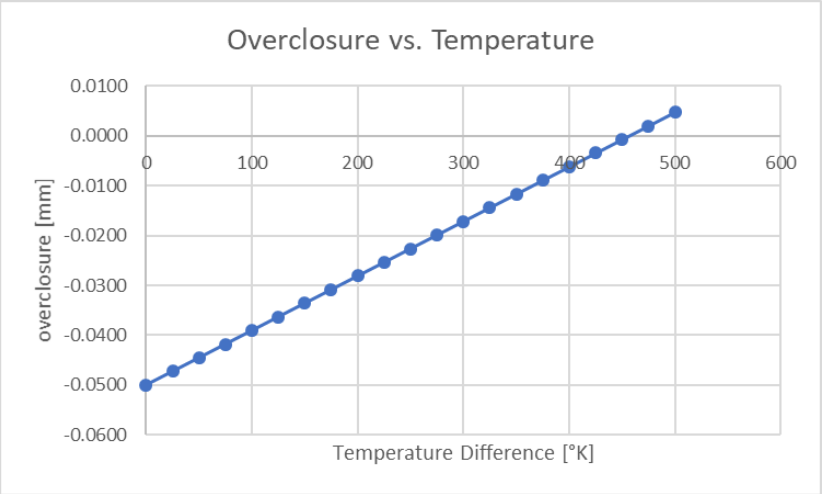

Figure 1

The analytically calculated overclosure during heating (x-axis) shows, that the disc clears the shaft at around 450°K temperature difference (positive overclosure). The maximum value (at 500°K) can be calculated as 0.0047mm. Thus, the maximum initial overclosure needs to be <0.0547mm in order to reach clearance of the two parts at 500°K.

Table 1

δ°K	disc radius [mm]	overclosure [mm]
0	9.950	-0.0500
25	9.953	-0.0473
50	9.955	-0.0445
75	9.958	-0.0418
100	9.961	-0.0391
125	9.964	-0.0363
150	9.966	-0.0336
175	9.969	-0.0308
200	9.972	-0.0281
225	9.975	-0.0254
250	9.977	-0.0226
275	9.980	-0.0199
300	9.983	-0.0172
325	9.986	-0.0144
350	9.988	-0.0117
375	9.991	-0.0090
400	9.994	-0.0062
425	9.997	-0.0035
450	9.999	-0.0007
475	10.002	0.0020
500	10.00473	0.0047

Mises Stress at different overclosures:

We tried 2 additional overclosures, one with 0.025mm and one with 0.01mm. Along with the original overclosure of 0.05mm we achieved following values for the maximum mises stress:

Table 2

Overclosure [mm]	Mises Stress [N/mm^2]
0.010	224.3
0.025	561.7
0.050	1126

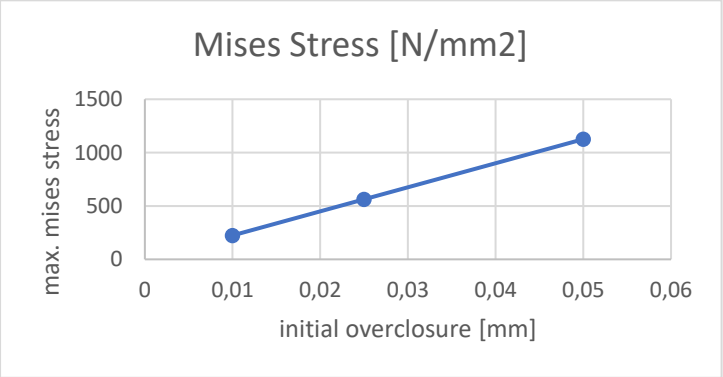

Figure 2

The maximum mises stress values can be approximated linearly. Double the overclosure results in roughly double the mises stress. This is only a qualitative estimate.

Contact Pressures at different overclosures:

We tried 2 additional overclosures, one with 0.025mm and one with 0.01mm. Along with the original overclosure of 0.05mm we achieved following values for the maximum contact pressures:

Table 3

Overclosure [mm]	Mises Stress [N/mm^2]
0.010	128.7
0.025	322
0.050	644.6

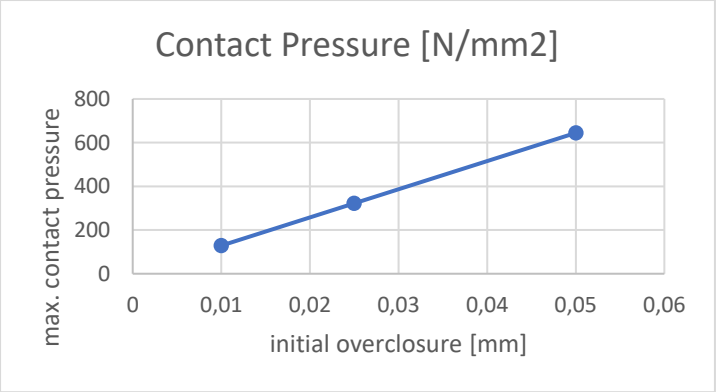

Figure 3

Similarly to the mises stress values, the contact pressures show an approximately linear behaviour.

To avoid plastic deformation, the maximum mises stress needs to remain below the yield stress of the material. With yield stresses of steel ranging between 200 – 300Mpa, we can therefore estimate (from Figure 2 and Table 2) a maximum allowed overclosure of roughly 0.01mm, in order to remain in the elastic region.