

The Effect of Pre-Stressing on the Static Indentation Load Capacity of the Superelastic 60niti



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Static Indentation Load Capacity of
the Superelastic 60NiTi

NASA Technical Reports Server
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(Mr. Edison Roberts IV)

THE EFFECT OF PRE-STRESSING ON THE STATIC INDENTATION LOAD CAPACITY OF THE SUPERELASTIC 60NITI

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BiblioGov. Paperback. Book Condition: New. This item is printed on demand. Paperback. 26 pages. Dimensions: 9.7in. x 7.4in. x 0.1in. Superelastic nickel-titanium alloys, such as 60NiTi (60Ni-40Ti by wt.), are under development for use in mechanical components like rolling element bearings and gears. Compared to traditional bearing steels, these intermetallic alloys, when properly heat-treated, are hard but exhibit much lower elastic modulus (approx. 100 GPa) and a much broader elastic deformation range (approx. 3 percent or more). These material characteristics lead to high indentation static load capacity, which is important for certain applications especially space mechanisms. To ensure the maximum degree of elastic behavior, superelastic materials must be pre-stressed, a process referred to as training in shape memory effect (SME) terminology, at loads and stresses beyond expected use conditions. In this paper, static indentation load capacity tests are employed to assess the effects of pre-stressing on elastic response behavior of 60NiTi. The static load capacity is measured by pressing 12.7 mm diameter ceramic Si₃N₄ balls into highly polished, hardened 60NiTi flat plates that have previously been exposed to varying levels of pre-stress (up to 2.7 GPa) to determine the load that results in shallow but measurable (0.6 m, 25 in. deep) permanent dents. Hertz stress calculations are used to estimate contact stress. Without exposure to pre-stress, the 60NiTi surface can withstand an approximately 3400 kN load before significant denting (0.4 m deep) occurs. When pre-stressed to 2.7 GPa, a static load of 4900 kN is required to achieve a comparable dent, a 30 percent increase. These results suggest that stressing contact surfaces prior to use enhances the static indentation load capacity of the superelastic 60NiTi. This approach may be adaptable to the engineering and manufacture of highly resilient mechanical components such as rolling element bearings....

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