

UNIVERSIDAD AUTONOMA DE OCCIDENTE

FACULTAD DE INGENIERÍA

PROGRAMA DE INGENIERÍA BIOMÉDICA

Diseño de Dispositivos Biomédicos

Prof. Oscar Campo, PhD

NOMBRE:

COD:

Identify the 7 figures of your student ID in the following way: **ABCDEFGH**. Use that key as data for this question:

1. Determine the probability of failure of a spring-leaf prosthetic foot subjected to a transverse load of $1400 \pm \mathbf{ABC}$ N on the ankle. The foot is made of a steel with a yield strength of $1613 \pm \mathbf{CDE}$ MPa and the Standard Deviation of applied stress is 167 MPa.
2. An archwire for orthodontic brackets has a diameter of 0.3 mm. The free length between brackets is 20 mm, the applied activation force is 30 ± 3.15 N. The archwire material is a Ti-Alloy with a yield strength of 450 MPa (SD=5% of the Yield Strength). The probability of failure for this condition is 1.6%. If you want to increase reliability to 99.99% or more, which one of the following strategies is the most feasible and why? A) Change the diameter of the archwire. B) Change the archwire material. Suppose the principal loads on the archwire are tensile. Table 4.1 shows the possible

materials for this application. Suppose $SD=5\%$ of the Yield Strength for all cases.

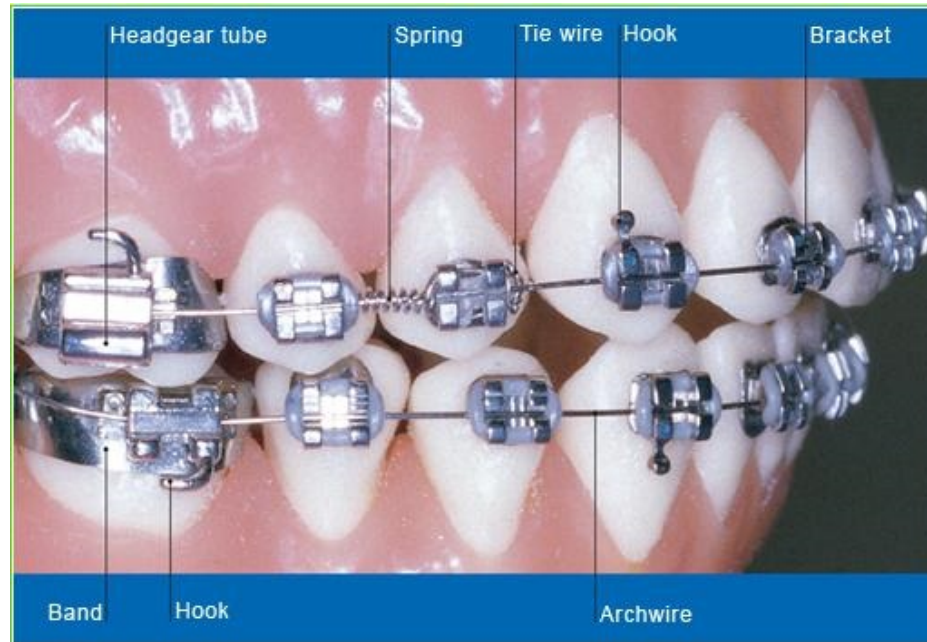


Table 4.1 Compositions and mechanical properties of the four major orthodontic wire alloy types

Wire Alloy	Composition (wt%)	Modulus of Elasticity (GPa)	Yield Strength (MPa) ^a	Springback ^b
Austenitic stainless steel	17–20 % Cr, 8–12 % Ni, 0.15 % C (max), balance mainly Fe	160–180	1100–1500	0.0060–0.0094 (AR) 0.0065–0.0099 (HT)
Cobalt-chromium-nickel (Elgiloy Blue)	40 % Co, 20 % Cr, 15 % Ni, 15.8 % Fe, 7 % Mo, 2 % Mn, 0.15 % C, 0.04 % Be	160–190	830–1,000	0.0045–0.0065 (AR) 0.0054–0.0074 (HT)
β -titanium (TMA)	77.8 % Ti, 11.3 % Mo, 6.6 % Zr, 4.3 % Sn	62–69	690–970	0.0094–0.011
Nickel-titanium	55 % Ni, 45 % Ti (approx. and may contain small amounts of Cu or other elements)	34	210–410	0.0058–0.016

From Brantley, 1997.

^aThe values of yield strength correspond to 0.1 % permanent tensile strain. ^bThe terms AR and HT for the stainless steel and Elgiloy Blue alloys refer to the as-received and heat-treated conditions, respectively.