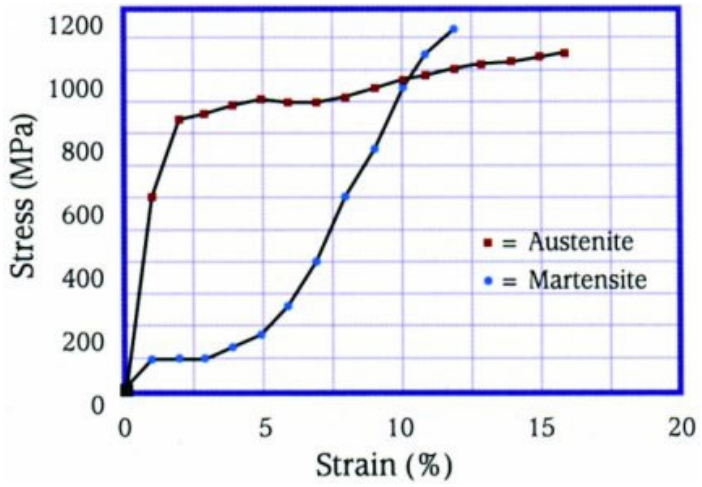
Shape Memory Alloys

Shape Memory Alloys (SMAs) refer to a group of materials which have the ability to return to a predetermined shape when heated. The shape memory effect is caused by a temperature dependent crystal structure. When an SMA is below its phase transformation temperature, it possesses a low yield strength crystallography referred to as Martensite (see Stress-Strain figure). While in this state, the material can be deformed into other shapes with relatively little force. The new shape is retained provided the material is kept below its transformation temperature. When heated above this temperature, the material reverts to its parent structure known as Austenite causing it to return to its original shape (see Phase Transformation figure). This phenomenon can be harnessed to provide a unique and powerful actuator.

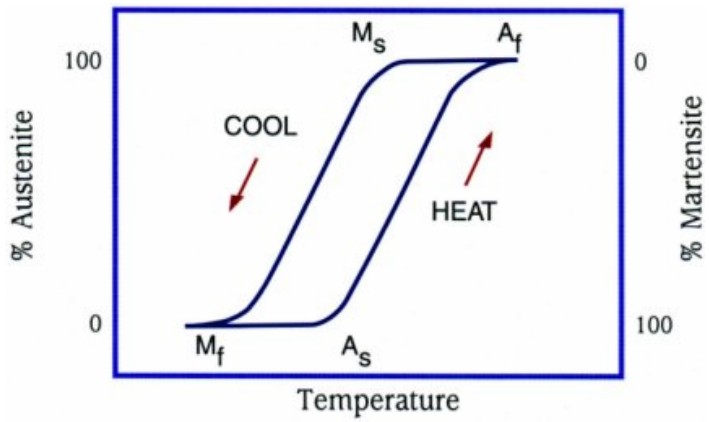
The most widely used shape memory material is an alloy of Nickel and Titanium called Nitinol. This particular alloy has excellent electrical and mechanical properties, long fatigue life, and high corrosion resistance. As an actuator, it is capable of up to 5% strain and 50,000 psi recovery stress, resulting in ~1 Joule/gm of work output. Nitinol is readily available in the form of wire, rod, and bar stock with transformation temperature in the range of -100º to +100º Celsius. More recently applications in Micro-Electro-Mechanical-Systems (MEMS) have led to the development of Nitinol in the form of sputter deposited thin film.

For more information about Shape Memory Alloy and its applications, contact TiNi Aerospace at the address below.

STRESS-STRAIN CHARACTERISTICS



PHASE TRANSFORMATION



Properties of Nitinol

Density	6.45 gm/cm^3	0.23 lb/in^3
Thermal Conductivity	10 W/m^{o}K	5.78 Btu/hr ft^{o}F
Specific Heat	322 j/kg^{o}K	0.08 Btu/lb^{o}F
Latent Heat	24,200 J/kg	10.4 Btu/lb
Ultimate Tensile Strength	750-960 Mpa	110-140 ksi
Elongation to Failure	15.5%	15.5 %
Yield Strength (Austenite)	560 Mpa	80 ksi
Young's Modulus (Austenite)	75 Gpa	11 Mpsi
Yield Strength (Martensite)	100 Mpa	15 ksi

TiNi AEROSPACE, Inc.
Innovative Mechanism Solutions

2235 Polvorosa Ave, San Leandro, CA 94577 Tel: (510) 483-2564 Fax: (510) 483-2032
E-mail: marketing@tiniaerospace.com Web: www.tiniaerospace.com