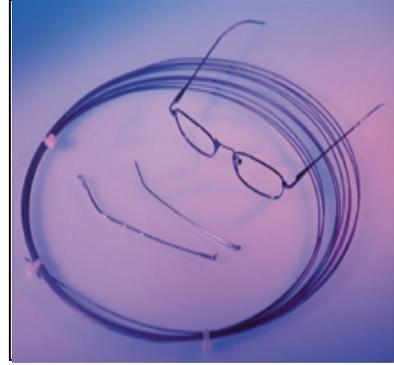


## Nitinol (Memory Metal) Fact Sheet

**Nitinol** is a shape memory alloy, a mixture of two types of metal (in this case nickel and titanium) that will bend but will return to its original shape when heated.



### COOL FACTS

- Nitinol stands for **N**ickel, **T**itanium, and the **N**aval **O**rdnance **L**aboratory, where it was invented in the 1960's.
- This metal has two states. When cool, Nitinol is in a bendable state and is very soft. At higher temperatures, it is in its rigid state and very springy.
- At a certain temperature, called the transition temperature, Nitinol changes from its bendable state to its rigid state, “remembering” the original shape (see training).
- This metal has been used to make trick spoons. The spoons are straight until placed in a cup of hot chocolate (coffee, tea, etc.), then they quickly bend in half, surprising the user!
- Nitinol has many other cool properties, such as superelasticity which making more “springy” springs, and “unbreakable” glasses frames. (See Q&A for explanation.)

### FAQ's

**Q:** Can Nitinol go back to a non-straight shape?

**A:** Yes! If you keep heating Nitinol above the transition temperature, it will reach a second transition temperature (usually around 500 °C!) where it can be bent, or *trained* permanently.

**Q:** Why isn't Nitinol used in everything (e.g. car panels where the dents pop out on a hot day)?

**A:** Right now, this material is too expensive to use in large quantities. However, as the technology used to make Nitinol advances, the price will decrease.

**Q:** What is the transition temperature of Nitinol?

**A:** It varies. By changing the composition of the metal (by changing the Ni/Ti ratio or with additives), the Nitinol can be “tuned” to a certain transition temperature: anywhere from – 140 °C (as cold as winter on Mars' poles) to 75 °C (as hot as a cooked chicken out of the oven).

**Q:** How do they make Nitinol superelastic?

**A:** When the metal is very close to the transition temperature, applying force is enough to change some atoms of the metal from one state to the other, bending the wire. When you let go (force is removed), the metal goes back to the rigid state, remembering its shape.

**RELEVANCE TO OUR LIVES:** Nitinol's shape memory has found use in many appliances as a switch that responds to either heat or electric current. Orthodontists use Nitinol as the wires for braces. In a person's mouth, the Nitinol warms, changes shape, and pushes on the teeth. This is less painful than steel wires, and allows for more time between orthodontist appointments. Super elasticity gives us “unbreakable” eye glasses frames and fish hooks, because the metal bends rather than breaking.

### RESOURCES:

Johnson Matthey: Nitinol Technical Data:

[http://www.jmmedical.com/html/nitinol\\_technical\\_information.html](http://www.jmmedical.com/html/nitinol_technical_information.html)

Memory-Metalle: [http://www.memory-metalle.de/html/01\\_start/index\\_outer\\_frame.htm](http://www.memory-metalle.de/html/01_start/index_outer_frame.htm)

NDC: Nitinol Applications: <http://www.nitinol.com/4applications.htm>