

# Superelastic alloy

## ASADA CORPORATION

<http://www.asada-metal.com/>

Asada Corporation is a specialized trading company  
for wires and strips such as steels, wires, piano wires,  
hard drawn steel wires, stainless steel wires etc.



# Shape Memory NT Alloy

Deformed NT shape memory alloy restores itself to its original shape when heat is applied to it. This process of remembering its original shape is why this alloy is now called a shape memory alloy.

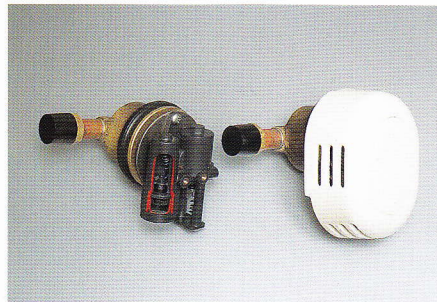
NT shape memory alloy is used in a wide variety of applications and diverse consumer fields. Prime examples are automobiles and household electrical appliances.

The NT alloy often functions as an actuator and sensor. If used effectively, the NT alloy can reduce the physical size of mechanisms, improve product reliability and provide a longer product service life.



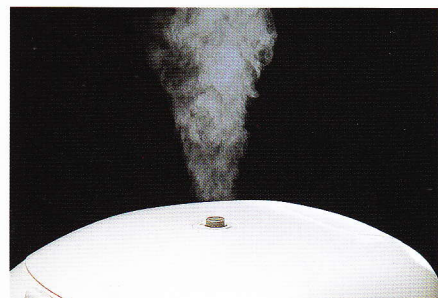
## Coffee maker

As water begins to boil, a shape memory spring opens a water stopper to let the boiling water pour over the coffee beans. This process removes 90% of the water's chlorine content and results in a richer tasting coffee and aroma.



## Bathtub adapter

A shape memory alloy is placed at the bathtub's hot water outlet. This increases the water mixing efficiency. When the water does not fully fill a bathtub, the shape memory alloy closes the outlet to prevent hot water discharge.



## Rice cooker

When the steam temperature reaches 70C, or 156F, a shape memory spring is used to open a pressure regulating port. The port is securely closed until the rice is thoroughly cooked. As the rice becomes soft and tender, the port opens at a set time interval to let the excess steam escape.



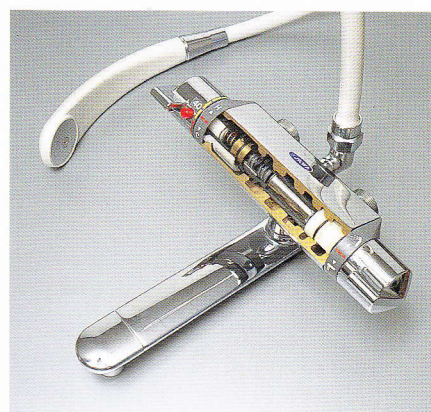
## Air conditioner for heating and cooling

A shape memory spring actuates a wind direction flap. The flap is directed downward for heating and upward for cooling, resulting in warm feet and cool heads.



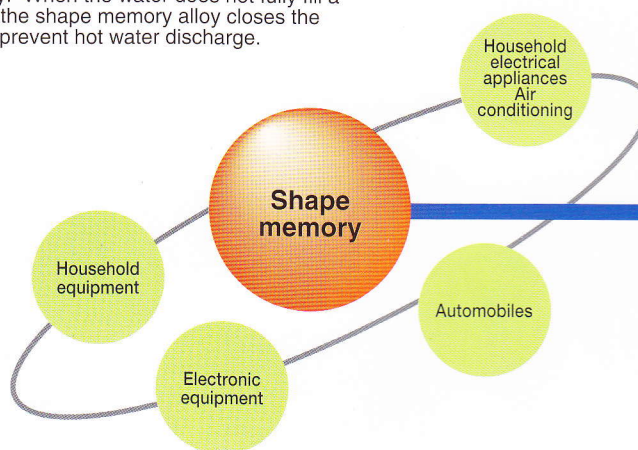
## Lamp shade

A shape memory spring heated by an electric light opens a lamp shade. This simple mechanism, creates a striking elegant movement of the lamp shade.



## Mixing valve

A shape memory spring adjusts the cold and hot water mixing ratio. When the mixing valve is opened, the water temperature change is kept to a minimum.



## Attitude control system of a stationary satellite

A shape memory spring opens and closes the solar cells that are mounted on the ends of solar batteries. This adjusts a satellite's position to the solar wind and controls the overall attitude of the satellite. The shape memory spring is highly reliable in this application.

## NT Alloy Product Features

- Superior memory shape restoration performance
- Recovers from high stress deformation
- Excellent corrosion resistance
- Strong restoration force
- Long fatigue life

## Integrated Production System

Furukawa offers a complete manufacturing solution in an integrated production system ranging from the melting operation through forming and machining fabricated parts. Product quality is highly controlled with strict engineering and manufacturing parameters.







**Antenna element wire for portable cellular telephones**

A super-elastic NT alloy wire is used as the element wire in retractable antennas for portable cellular telephones. It has superior strength and quickly recovers its straight form when bending stresses are removed. It is being used by a majority of the portable cellular telephone manufacturers throughout the world.

This alloy behaves like a rubber material with a very wide elastic region. It can be bent or deformed, but its extraordinary elasticity allows it to recover its original shape when the bending or deformation stress is removed. This unique elasticity feature of the super-elastic NT Alloy has been implemented in a wide variety of springs, wires and tube applications for clothing accessories, personal accessories, electronic devices and treatments in the medical and dental fields.



**Eyeglass frames**

The super-elastic NT alloy is used for the temple and bridge structures of eyeglass frames. It improves the comfortable fitting of wearing eyeglasses and exhibits exceptional strength withstanding large deformation stress.



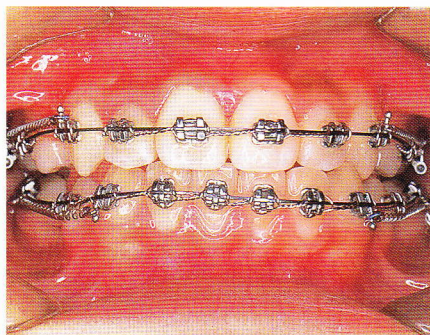
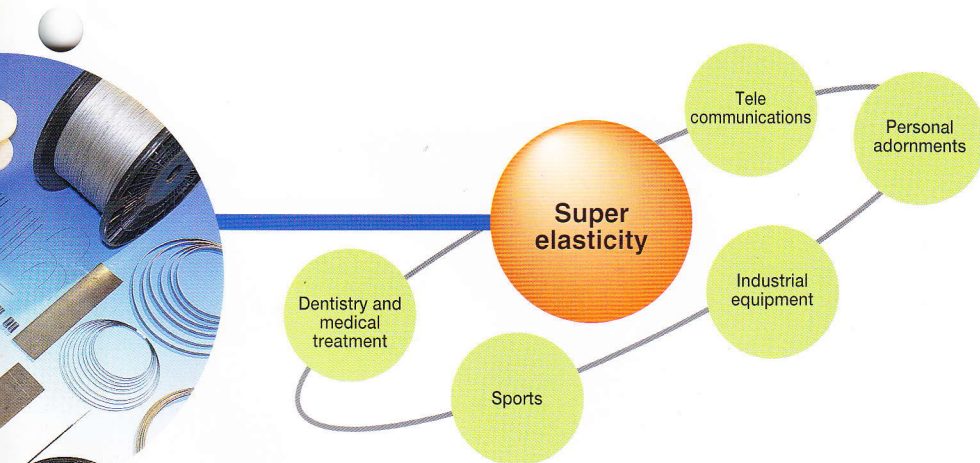
**Brassiere**

A super-elastic NT alloy wire is used as the brassiere frame. It has gained wide popularity for the beautiful body line, soft feel and elastic fitting that it provides.



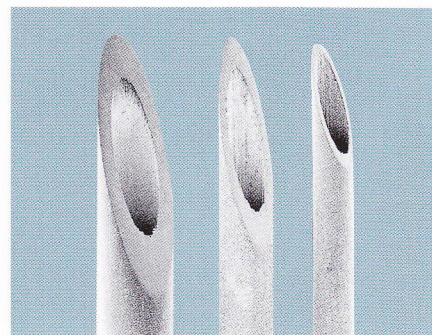
**Wedding dress petticoat**

A super-elastic NT alloy wire is used as the core wire of a wedding dress petticoat. The super-elastic wire enhances the gown's shape and silhouette. The NT wire can be folded into a compact size for storage and transport.



**Orthodontic wire**

Super-elastic NT alloy wire is used as an orthodontic appliance to help straighten teeth. The super elasticity continually applies force to the mis-aligned teeth and returns them to their proper alignment. Super-elastic NT alloy wire contributes to the best possible results of orthodontic treatment.



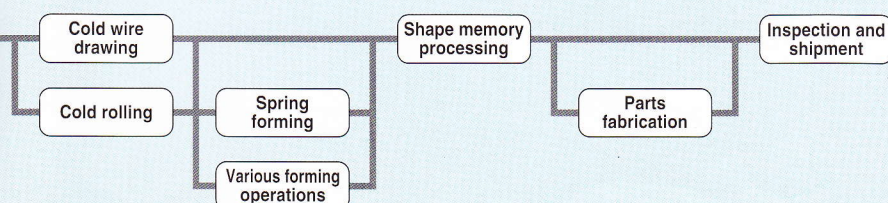
**NT tube**

Furukawa's R&D team has developed a process to fabricate a thin-wall, small diameter super-elastic NT tube. It is expected that there are many potential applications.



**Paint gun**

Super-elastic NT alloy wire is used as the pin electrodes in a paint gun. The wire's high resistance to permanent deformation endures the high pressure of the paint gun and improves the service lives of the pin electrodes.



## NT Alloy shapes

Furukawa NT alloy is available in a wide variety of shapes. Shapes currently available are round wire, square wire, extremely thin wire, springs, tapes, plates, foils, tubes and other three-dimensional objects. Furukawa can customize these shapes to your specific requirements with our proprietary forming and shape memory processes.



# Properties of Furukawa NT Alloy

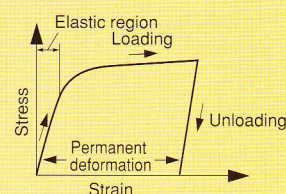
When ordinary metallic materials have an excessive stress load applied, beyond their elastic regions, they are not able to fully restore their original shapes. After the excessive stress load is removed, a permanent deformation remains.

When Furukawa's NT shape memory alloys have an excessive stress load applied, beyond its elastic region, at a temperature less than the transformation ( $A_f$ ) temperature, it undergoes a plastic-like deformation. When heat, higher than the transformation temperature is applied, the deformation disappears and the original shape is restored.

Furukawa's super-elastic NT alloy can accept an excessive stress load up to ten times the alloy's elastic stress region, at a temperature higher than the transformation temperature.

When the excessive stress load is removed, the deformation disappears and the alloy restores its original shape.

Ordinary metal material



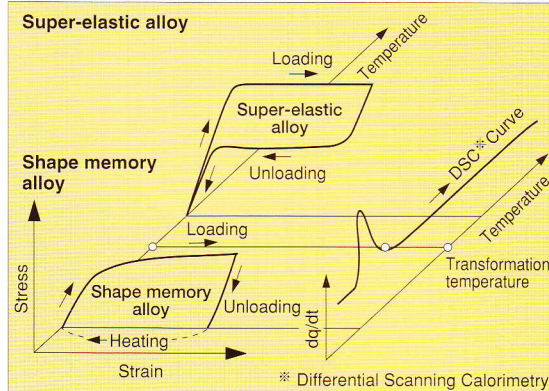
## Physical properties of Furukawa NT Alloy

Density	g/cm <sup>3</sup>	6.4~6.5
Melting Point	°C	1240~1310
Specific heat	J/(kg·K) {cal/(g·°C)}	230~314 {0.056~0.075}
Linear expansion co-efficient	10 <sup>-6</sup> /°C	10
Heat conductivity	W/(m·K) {cal/(cm·°C·sec)}	20 {0.05}
Specific resistance	10 <sup>-6</sup> Ω m { μ Ω cm}	0.5~1.1 {50~110}

## Mechanical properties of Furukawa NT Alloy

Tensile strength	Material that is heat treated	MPa {kgf/mm <sup>2</sup> }	686~1470 {70~150}
	Material that is not heat treated	MPa {kgf/mm <sup>2</sup> }	1176~1960 {120~200}
Elongation	Material that is heat treated	%	~60
	Material that is not heat treated	%	~25

Super-elastic alloy



# Wide variety of NT Alloy types

Furukawa offers a wide variety of NT alloy formulations to meet your shape memory characteristics, super-elastic characteristics and customer specific requirements. A wide range of transformation temperatures are also available. Please contact us with your specific requirements. We can offer further information and guidance to engineer your custom device design requirements.

Effect	Symbol	Alloy types	Range of transformation temperatures (°C)	Restorable deformation (%)	Temperature hysteresis (°C)	Durability	Application example
Shape memory effect	NT-M NT-LS	Ni-Ti Ni-Ti-Fe	0~70	1	2~3	>1,000,000	Sensor actuator designed for a long service life
	NT-H	Ni-Ti-Cu	50~80	5~6	10~15	10,000~50,000	Sensor actuator designed for a large stroke
	NT-M	Ni-Ti	-10~100	6~8	20~40	<100	Connector Joint
Effect	Symbol	Alloy types	Range of transformation temperatures (°C)	Super-elastic stress (MPa {kgf/mm <sup>2</sup> })	Stress hysteresis (MPa {kgf/mm <sup>2</sup> })	Feature Application	Application example
Super-elastic effect	NT-E NT-L	Ni-Ti Ni-Ti-Fe	-20~50	294~588 {30~60}	245~428 {25~45}	Long service life Good machinability	<ul style="list-style-type: none"> <li>Various spring devices</li> <li>Antenna core wire</li> <li>Brassiere wire</li> <li>Frame of glasses</li> <li>Orthodontic wires</li> </ul>
	NT-N NT-RA	Ni-Ti Ni-Ti-Cr		490~882 {50~90}		High super-elastic stress	
	NT-HR	Ni-Ti-Cu-Cr		294~588 {30~60}	98~294 {10~30}	Low stress hysteresis	



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