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(Af) 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.

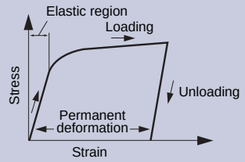
Physical properties of Furukawa NT Alloy

Density	g/cm^3	6.4～6.5
Melting Point	℃	1240～1310
Specific heat	J/(kg・K) {cal/(g・℃)}	230～314 {0.056～0.075}
Linear expansion co-efficient	10^{-6}/℃	10
Heat counductivity	W/(m・K) {cal/(cm・℃・sec)}	20 {0.05}
Specific resistance	$10^{-6}\Omega$m {$\mu\Omega$cm}	0.5～1.1 {50～110}

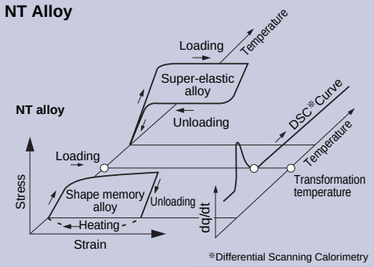
Mechanical properties of Furukawa NT Alloy

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

Ordinary metal material



NT Alloy



※Differential Scanning Calorimetry

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.

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 (℃)	Restorable deformation (%)	Temperature hysteresis (℃)	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 (℃)	Super-elastic stress (MPa {kgf/mm^2})	Stress hysteresis (MPa {kgf/mm^2})	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	・Various spring devices ・Antenna core wire ・Brassiere wire ・Frame of glasses ・Orthodontic wires
	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	

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.

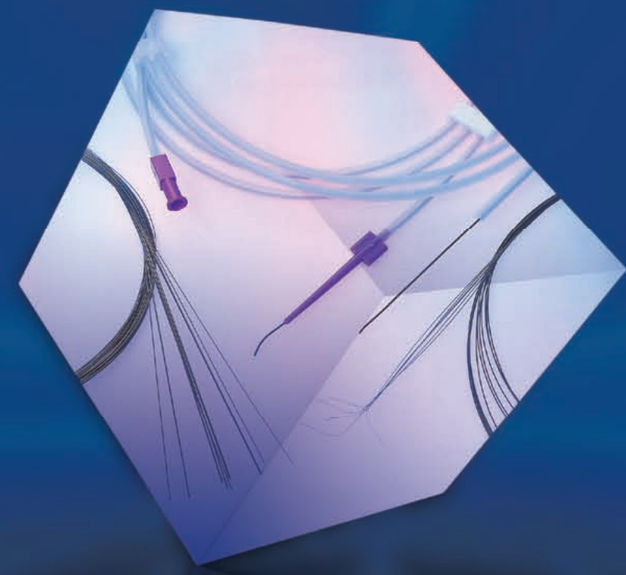
SE-058 1I12 TR 50

returning to its original shape when heated

Shape Memory NT Alloy

showing rubber-like deformation behavior

Super-Elastic NT Alloy



FURUKAWA NT ALLOYS

FURUKAWA ELECTRIC

Shape Memory NT Alloy

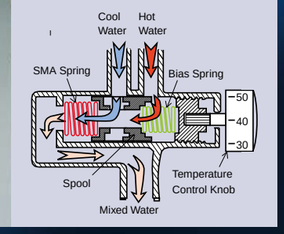
Deformed NT shape memory alloy restores itself to its original shape when heat is applied to it. This process of remembering its original shape is why this alloy is now called a shape memory alloy. NT shape memory alloy is used in a wide variety of applications and diverse consumer fields. Prime examples 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.

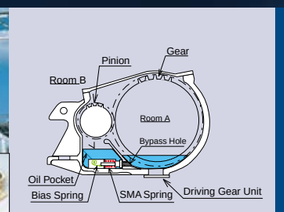
Autotronic CVT for the new Mercedes-Benz A-Class

SMA NT spring automatically senses temperature change and exerts a significant (calculated) forceto actuate the valve.
In the case of the A-Class transmission, the valve system automatically changes the direction of oil flow.

Water mixing valve

Used in a thermostat type water mixing faucet, SMA spring will adjust flow of hot and cold water precisely to the set temperature. It reacts faster than the ordinary wax system and the water temperature will remain stable following changes in water pressure.



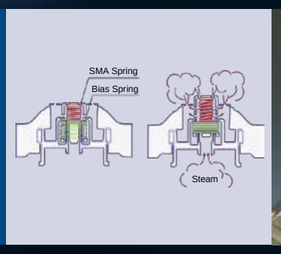


Automatic oil valve adjusting device for Shinkansen

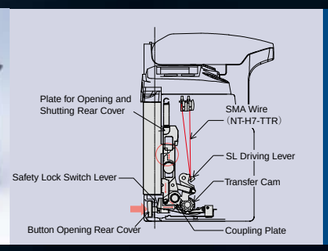
The latest models of Shinkansen (also known as the Bullet train), are equipped with aluminum gearboxes that incorporate an automatic oil level adjusting system (valve). The valve with an SMA spring controls the oil level inside the gearbox according to the change of oil temperature. Installing this system achieved a reduction of oil temperature of 30℃.

Electric Rice cooker

The pressure control valve of rice cooker is tight shut until the rice inside has become nice and fluffy. When steam inside hit 70℃, SMA spring opens the valve to release the excess vapor. It closes the valve when keeping rice warm to prevent from drying.



New Technology



SMA wire for electrical current operated actuator

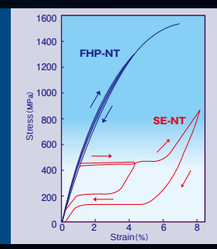
NT-H7-TTR, the world's first SMA wire for electrical current operated actuator has superior power efficiency. This enables the designer to make a device with minimal space, which is lightweight, simple structure and noise free.

Film chamber lock for Camera

The first application of NT-H7-TTR is a film chamber lock using a miniature actuator. It protects loaded films from opening accidentally.

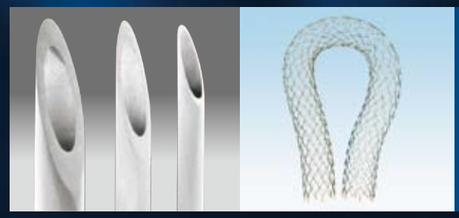
FHP-NT wire for Guidewire

Although it is elastic and flexible, FHP-NT is not SEA, and of course not SMA. It has completely individual properties, we call it "The 3rd property of NiTi". Unique production process has achieved superior straightness, greatly improved pushability, torque transmitting ability and very high (as high as 3 times) stiffness compared to the ordinary SEA wires.



Super-Elastic NT Alloy

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.



NT Tube

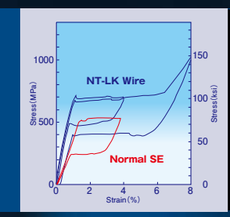
The production of SEA tubes used to be a challenge of technology.
We have established a product line with a wide range of sizes and properties, all of superb quality. Increasing high levels of demand for this product have been forthcoming from the Medical Device Industry.

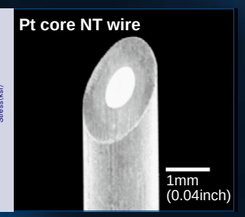
Stent

Vascular implant ("Stent") made of Furukawa NT tubes. Stents are implanted into occluded blood vessels and act as scaffolds to recover the lumen diameter. The superelastic alloy enables; high flexibility, non kinking and high radial strength.

Super-elastic wire for Guidewire

We have many alloys in our product range for medical Guidewire applications. We are developing, existing and new alloys e.g. Ultra high plateau stress, Good radiopacity, and Ni-free alloy….. to suit the customer's applications.





[before treatment]

[after treatment]

Orthodontic Wire

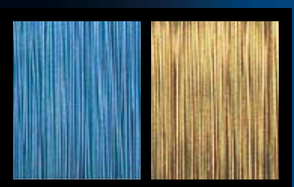
SEA Round and Square wires are used for braces. Their constant recovery forces throughout straining reduces unpleasant sensations for patients. An ideal choice for braces.

Eyeglass Frames

Utilizing SEA for the temple and bridge, NT Eyeglass frames can stand excessive straining and offer superior comfort. Its unique quality is also ideal for children's glasses too.

Core wire for Cellular phone Antenna

SEA wire is globaly used as the core wire of the retractable antenna for cellular phone.
It quickly recovers its straight memory when bending stresses are removed.



Blue,0.063mm dia. Gold,0.058mm dia.

NT wire for Fishing Line

Very thin SEA wires (0.043~0.090mm) are used for Ayu (Sweet fish, a small river fish) fishing metal line. Superior elasticity (rubberness) gave NT wires excellent anti-shock property, making them "the metal line with nylon feeling".

Bound to Innovate

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