

# FURUKAWA TECHNO MATERIAL

Ni-Ti Alloy

Super Elastic & Shape Memory



## Medical

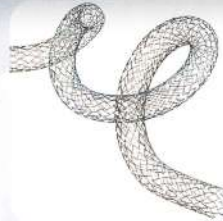
### Ni-Ti Tube

Super-elastic Ni-Ti tubes with excellent durability are suitable for medical devices. Tubes are available in various sizes and alloy types.



### Stent

Self-expandable vascular Stent made of highly durable Furukawa Ni-Ti alloys are implanted into occluded blood vessels and act as scaffolds to secure the lumen diameter.



### Heart Valve

High elasticity and superb durability of Furukawa Ni-Ti alloy are the best match for cardiac applications.



### Guidewire

Full range of super elastic NiTi wires including Ultra high plateau stress FHP-NT, excellent radiopacity Pt-Cored wire, are ready for medical Guidewire applications.



### Orthodontic Wire

Super-elastic round and square wires are used for orthodontic braces. Their constant recovery forces throughout straining reduces unpleasant sensations for patients.



## Shape Memory Applications

### Automatic CVT (automobile)

Ni-Ti spring senses the temperature and actuates the oil flow control valve inside the CVT. It contributes to a better fuel efficiency.



### Automatic oil valve adjusting device (Shinkansen Train)

The unit with Ni-Ti spring detects the temperature change and controls the oil level inside the aluminum gearbox. It prevents the temperature rise.



### Water mixing valve for Faucet

Ni-Ti spring with a good thermal response adjusts the flow of hot and cold water precisely and quickly to the set temperature.





## Alloy Characteristics

When ordinary metals 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 Ni-Ti shape memory alloys have an excessive stress load applied, beyond its elastic region, at temperatures less than the transformation ( $A_f$ ) temperature it shows plastic deformation behavior. When heat higher than the  $A_f$  is applied the deformation disappears and the original shape is restored. Super-elastic Ni-Ti alloys can take an excessive strain up to ten times of an elastic stress region of typical alloys. When the excessive strain is removed the deformation disappears and the alloy restores its original shape.

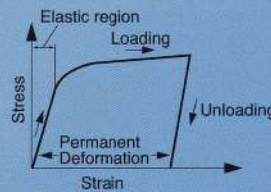
### Physical Properties

Density	$\text{g/cm}^3$	6.4~6.5
Melting Point	$^{\circ}\text{C}$	1240~1310
Specific Heat	$\text{J}/(\text{kg}\cdot\text{K})$ { $\text{cal}/(\text{g}\cdot^{\circ}\text{C})$ }	230~314 {0.056~0.075}
Linear expansion coefficient	$10^{-6}/^{\circ}\text{C}$	10
Heat conductivity	$\text{W}/(\text{m}\cdot\text{K})$ { $\text{cal}/(\text{cm}\cdot^{\circ}\text{C}\cdot\text{sec})$ }	20 {0.05}
Specific Resistance	$10^{-6}\Omega\text{m}$ ( $\mu\Omega\text{cm}$ )	0.5~1.1 {50~110}

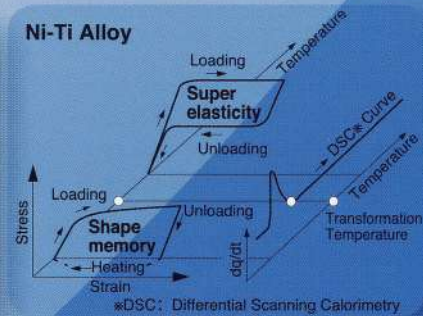
### Mechanical Properties

Tensile strength	Heat treated	MPa	600~1500
	As-drawn	MPa	1200~2000
Elongation	Heat treated	%	~60
	As-drawn	%	~25

#### Ordinary Metal



#### Ni-Ti Alloy



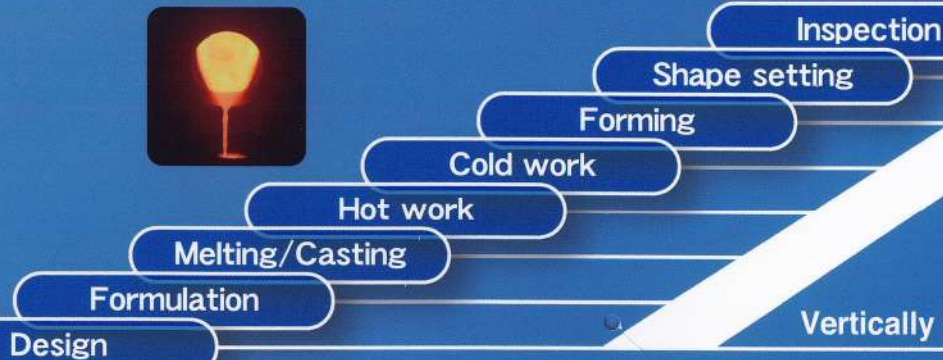
## Alloy Line-up

Furukawa offers a wide variety of Ni-Ti alloy formulations to meet your shape memory or super-elastic characteristics requirements. A wide range of transformation temperatures are also available. Please contact us with your specific needs for our further information and guidance to engineer your custom device designs.

Property	Symbol	Alloy Types	Transformation Temp. Range ( $^{\circ}\text{C}$ )	Restorable Deformation (%)	Temperature Hysteresis ( $^{\circ}\text{C}$ )	Durability	Applications
Shape memory Effect	NT-M	Ni-Ti	0~70	1	2~3	>1,000,000	Sensor actuator designed for a long service life
	NT-LS	Ni-Ti-Fe					
	NT-H	Ni-Ti-Cu	50~80	5~8	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

Property	Symbol	Alloy Types	Transformation Temp. Range ( $^{\circ}\text{C}$ )	Super-elastic (MPa)	Stress Hysteresis (MPa)	Feature Application	Applications
Super-elastic Effect	NT-E4, E9	Ni-Ti	-20~50	300~600	250~430	Long service life Good machinability	<ul style="list-style-type: none"> <li>Medical Stents</li> <li>Medical Guidewires</li> </ul>
	NT-L	Ni-Ti-Fe					
	NT-N	Ni-Ti		400~800	100~300	High super elastic stress	<ul style="list-style-type: none"> <li>Orthodontic wire</li> <li>Antenna core wire</li> </ul>
	NT-RA	Ni-Ti-Cr					
	NT-HR	Ni-Ti-Cu-Cr	300~600		Low stress hysteresis	<ul style="list-style-type: none"> <li>Brassier wire</li> <li>Eyeglass frame</li> </ul>	

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.



Vertically Integrated Manufacturing

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