

Knight[®] Precision Wire... Special Alloys

Product Information

Technical Information

NICKEL AND NICKEL ALLOYS

Nickel is a very versatile metal and although very useful in its commercially pure forms, it is its ability to alloy with a range of metals which has brought it to the forefront of modern metallurgy.

A range of highly alloyed materials has developed to provide high strength and excellent corrosion resistance, particularly at elevated temperatures, to meet specific requirements in many different types of environment.

Knight Precision Wire's stock of nickel and nickel based alloys falls into the following categories:

- Commercially Pure Nickel Alloy 200
- Nickel-Copper Alloy Alloy 400
- Nickel-Chromium-Iron Alloy Alloy 600
- Nickel-Chromium-Cobalt Alloy Alloy 90

Commercially Pure Nickels

These materials are characterised by high density, offering low electrical resistivity, high thermal conductivity and high magnetic properties.

Nickel-Copper Alloys

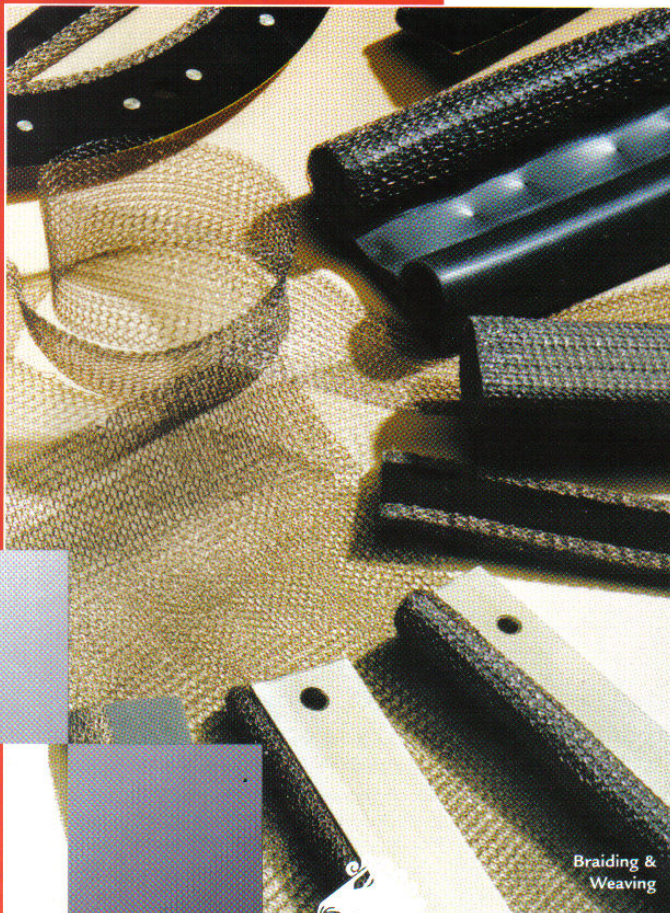
Nickel-copper alloys have been found to possess excellent corrosion resistance in reducing chemical environments and also in sea water, i.e. marine environments, where they are commonly used. They have good ductility and can be readily fabricated.

Nickel-Chromium-Iron Alloys

This group of alloys lead the way to higher strength and resistance to elevated temperatures. Initially developed for use in the chemical processing industry where carburising environments and elevated temperatures were too severe for stainless steels.

Nickel-Chromium-Cobalt Alloys

Nickel-chromium-cobalt alloys are represented by Alloy 90, a popular heat resistant spring material with good corrosion resistance which can be used in applications at temperatures above 350°C. Generally available in the solution-treated or cold drawn condition, it is an age hardenable alloy.



Courtesy of RPI Shielding Ltd.

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Materials Quality Standards

The grades of nickel and nickel alloys available are shown under their ASTM designation, along with their specific unified number from the Unified Numbering System. Grades available within British Standard BS 3075 are highlighted.

These materials are supplied in the bright drawn and annealed condition and also in a variety of tempers to suit the customers applications.

Knight[®] Precision Wire...

Special Alloys



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Titanium & Titanium Alloys

The element titanium has been known for many years but it is only in the last 50 years or so that it has gained importance. The rapid growth of the titanium industry has been due to the versatility of the metal and its alloys and their outstanding strength to weight ratios.

The properties of high strength, light weight and exceptional corrosion resistance have led to traditional applications in chemical processing plant, aerospace structures, jet engine components and medical implants.

Titanium exists in two crystallographic forms and its alloys can be classified into three categories:

- alpha
- alpha/beta
- beta alloys

Pure titanium has an alpha structure but transforms to a beta form when heated above 882°C. The addition of alloying elements influences this transformation and many alloys have been developed where beta phase is retained at room temperature, thus giving a material containing alpha and beta phases. The relative amounts of these phases give rise to variations in properties such as ductility, weldability and ease of forming.

Materials Quality Standards

Knight Precision Wire's range of titanium alloys concentrates on commercially pure alpha grades and the popular alpha/beta grade Ti 6Al 4V, all contained in ASTM B348 specification.

NICKEL & NICKEL ALLOYS GRADE DESIGNATIONS & CHEMICAL COMPOSITIONS (% by weight)

STANDARD	ASTM		CHEMICAL COMPOSITIONS											
	ALLOY	UNS	Ni	Cr	Fe	Co (max)	Mo	Cu (max)	C (max)	Mn (max)	Si (max)	S (max)	P	OTHERS
Commercially Pure Nickel														
NA11	200	N02200	99.0 min	-	0.40	-	-	0.25	0.15	0.35	0.35	0.01	-	Mg 0.20 max Ti 0.10 max
Nickel-Copper Alloy														
NA13	400	N04400	63.0 min	-	2.50	-	-	28.0 to 34.0	0.30	0.20	0.50	0.025	-	-
Nickel-Chromium-Iron Alloy														
NA14	600	N06600	72.0 min	14.0 to 17.0	6.0 to 10.0	-	-	0.5	0.15	1.00	0.50	0.015	-	-
Nickel-Chromium-Cobalt Alloy														
NA19	90	N07090	balance	18.0 to 21.0	1.50	15.0 to 21.0	-	0.20	0.13	1.00	1.00	0.015	-	Al 1.0 to 2.0 Ti 2.0 to 3.0 Zn 0.15 max B 0.020 max

Nickel-Titanium Shape Memory Alloy

The phenomenon of shape memory alloy is due to the ability of Nickel-Titanium alloys to have two sets of mechanical properties which sit astride a transformation temperature.

At temperatures below the transformation temperatures, the alloy has a martensitic structure which has a low yield point and is easily formed.

When heated above the transformation temperature there is an increase in rigidity and the material takes on the properties of a high tensile steel and returns to its original shape.

A popular application of Nickel-Titanium alloy is thermosensors in heating/air conditioning, but they are also used in orthodontic and medical implant applications.

The alloy exhibits good resistance to fatigue and excellent corrosion resistance.

TITANIUM & TITANIUM ALLOYS GRADE DESIGNATIONS & CHEMICAL COMPOSITIONS (% by weight)

STANDARD	CHEMICAL COMPOSITIONS							
	ALLOY	C (max)	N (max)	O (max)	H (max)	Fe	Ti	OTHERS
Alpha								
Grade 1	R 50250	0.10	0.03	0.18	0.015	0.20	balance	-
Grade 2	R 50400	0.10	0.03	0.25	0.015	0.30	balance	-
Grade 3	R 50550	0.10	0.05	0.35	0.015	0.30	balance	-
Grade 4	R 50700	0.10	0.05	0.40	0.015	0.50	balance	-
Alpha/Beta								
Ti 6Al 4V	R 56400	0.10	0.05	0.20	0.015	0.30	balance	Al 5.5 to 7.5 V 3.5 to 4.5

NICKEL & NICKEL ALLOY MECHANICAL PROPERTIES				
ASTM BS 3075	ALLOY BS 3075	TEMPER	TENSILE STRENGTH (N/mm ²) MIN	ELONGATION % MIN (50MM GAUGE LENGTH)
Commercially Pure Nickels				
200	NA11	Annealed Cold Drawn	380 460 - 540	20
Nickel-Copper Alloy				
400	NA13	Annealed Cold Drawn	480 690 - 770	20
Nickel-Chromium-Iron Alloy				
600	NA14	Annealed Cold Drawn	550 770 - 850	20
Nickel-Chromium-Cobalt Alloy				
90	NA19	Annealed Cold Drawn	1080 max 1540 max	30
		Precipitation Hardened... Annealed Cold Drawn	1080 1310 - 1540	

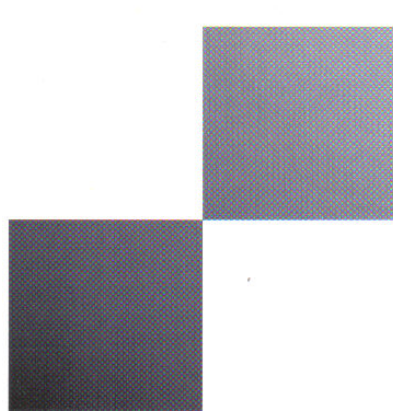
A range of minimum tensile strengths is given to reflect the variation of UTS with wire diameter. Please consult BS 3075.



Courtesy of RFI Shielding Ltd.

RFI shielding application

TITANIUM & TITANIUM ALLOY MECHANICAL PROPERTIES			
ASTM BS 348	TEMPER	TENSILE STRENGTH (N/mm ²) MIN	ELONGATION % MIN (50MM GAUGE LENGTH)
Grade 1	-	240	24
Grade 2	-	340	20
Grade 3	-	440	18
Grade 4	-	550	15
Ti 6Al 4V	Annealed	900	14
	Precipitation Hardened... Annealed	1150	8



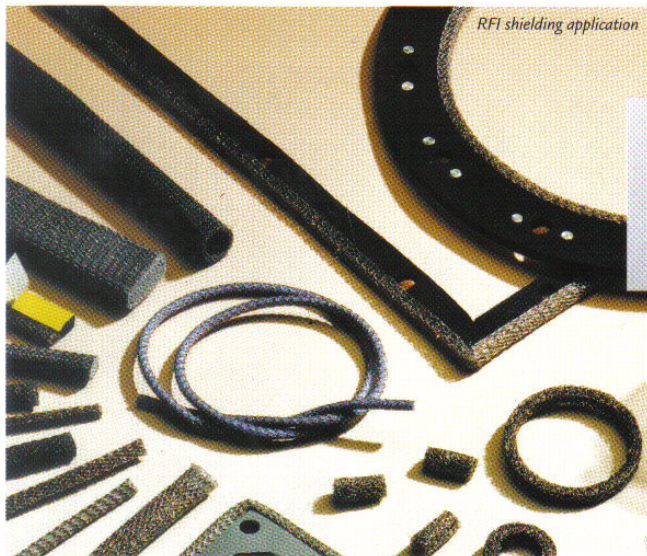
Special Alloys

PW05

SPECIAL ALLOYS STOCK RANGE	DIAMETER (mm)	
	Min	Max
COMMERCIALLY PURE NICKEL	0.05	4.00
NICKEL-COPPER ALLOY	0.05	4.00
NICKEL-CHROMIUM-IRON ALLOY	0.05	4.00
NICKEL-CHROMIUM-COBALT ALLOY	0.30	4.00
COMMERCIALLY PURE TITANIUM (Grades 1, 2, 3, 4)	0.05	4.00
Ti 6Al 4V	0.05	4.00

For our full product range and processing capability, please see Section PW01.

ALLOY	SERVICE PROPERTIES	APPLICATIONS
200	Commercially pure nickel. Good mechanical properties, excellent corrosion resistance.	AEROSPACE LOCKING WIRE, BATTERY TAGS
400	High strength and good corrosion resistance (particularly in sea water).	BRAIDING, MARINE ENGINEERING, FASTENERS
600	Resists oxidation up to 1200°C. High temperature, high strength alloy.	FURNACE COMPONENTS, CHEMICAL & FOOD PROCESSING
90	Good corrosion resistance, suitable for relatively high temperature components.	SPRINGS, FASTENERS
COMMERCIALLY PURE TITANIUM		
Grade 1	Excellent corrosion resistance, maximum formability, limited strength.	HEATING COILS, HEAT EXCHANGERS
Grade 2	Very good formability, good strength.	SPORTS EQUIPMENT
Grade 3	Good formability, high strength.	PLATING JIGS, ANODISING JIGS, ORTHODONTIC PINS
Grade 4	Highest strength of commercially pure grades, limited ductility.	
Ti 6Al 4V	Most widely used titanium alloy, excellent fatigue strength.	SPRINGS FOR HIGH TEMPERATURE



Courtesy of RFI Shielding Ltd.

The data printed in the above sections is based on information from our own and other organisations; although every effort has been made to ensure its accuracy, no guarantee or warranty is given or implied as to fitness for specific applications. Those suggested are for the purpose of illustration only and it is the responsibility of the user to decide on the most suitable product for any use or purpose whatsoever.

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