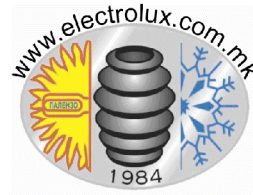


introduction



Founded in 1984, Electrolux is a world leader in the manufacture of precision drawn round wire, flat wire and shaped wire in a comprehensive range of High Performance Nickel alloys. It is a privately owned company with all shares held by the employees of the company, a situation that creates interest, loyalty and commitment. Today, Electrolux is a highly developed modern company that has become well respected within the wire industry. Electrolux manufactures to exacting specifications and demands for a wide variety of applications, including precision springs and components for use in gas turbines, oil, chemical and process plant, aerospace and nuclear industries, mechanical seals and medical implants. Electrolux combines the commitment of its staff with the efficiency of its operation to provide a service that is second to none. The motivation and innovation of the management team together with the skill and dedication of the workforce ensure that each and every requirement of your order is met rapidly and to the highest quality. The following pages are intended to help buyers, designers and engineers who wish to use these High Performance alloys. We hope that the information is useful and welcome any comments on how to improve the presentation. Electrolux has offices all over the world.


For details of your local office please visit: www.electrolux.mk



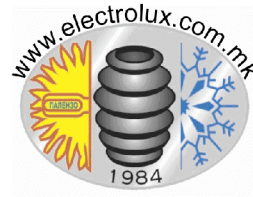
services

- We **MANUFACTURE** round and shaped wire
- Produced to **YOUR SPECIFICATION**
- Sizes from **20mm (.787") - 0.025mm (.001")**
- Order quantities from **As low as a few metres/feet**
- Typical **LEAD TIME** of 2 weeks
- **EMERGENCY** manufacturing service (EMS)
- **RE-DRAW** facility for **FREE ISSUE STOCK**



 Electrolux Macedonia
Bitola/Europe
+389(0)47 203 330

www.electrolux.mk www.elektroluks.mk www.elektroluks.eu
electrolux@t-home.mk elektroluks@t-home.mk

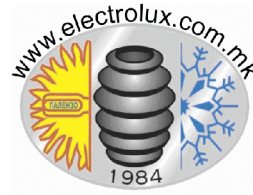


products, custom made

WE MANUFACTURE



- Round and shaped wire, produced on machinery specifically designed to precisely suit Electrolux's requirements
- Wire produced to your specification!
- With a typical lead time of 2 weeks
- And hold up to 80 tons of material in stock at any one time



SMALL QUANTITIES

- order quantities from as low as 1 kg (2lbs)
- manufactured to customer specification
- emergency manufacturing service available (EMS)

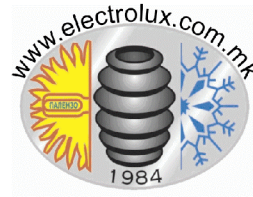


to customer specification



SIZE RANGE

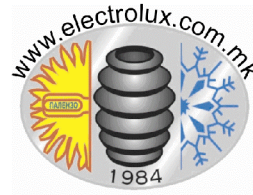
- **wire diameters:**
from 20mm (0.787")
to 0.025mm (0.001")
- **rolled products:**
width from 8mm (0.300")
to 0.13mm (0.005")
thickness from 4mm (0.160")
to 0.025mm (0.001")
- **straight lengths:**
from 3m (10')
to 3mm (0.125")



COMPLETE SERVICE

- all our staff are trained to be able to answer your enquiry personally
- fast delivery
- skilled workforce. Average experience of more than 15 years





Inconel 600*

W.NR 2.4816
UNS N06600
AWS 010

* Trade name of Special Metals Group of Companies

A Nickel-Chromium alloy with good resistance to oxidation and corrosion at high temperatures.

Applications include:

furnace components, chemical and food processing and nuclear engineering.

**APPROXIMATE
CHEMICAL COMPOSITION**

Ni	72% min
Cr	14 - 17%
Fe	6 - 10%

DENSITY	8.47 g/cm³	0.306 lb/in³
MELTING POINT	1413°C	2575°F
COEFFICIENT OF EXPANSION	13.3 μm/m•°C (20-100°C)	7.4x10⁻⁴ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	75.6 kN/mm²	10965 ksi
MODULUS OF ELASTICITY	206 kN/mm²	29878 ksi

CONDITION OF SUPPLY

HEAT TREATMENT (AFTER FORMING)

Annealed/Spring Temper

Stress relieve at **460°C (860°F)** for 1 hour and air cool.

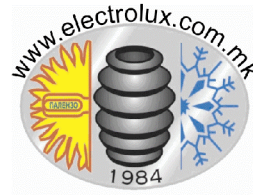
CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	600 - 750	87 - 109	-200° to +330°C	-330° to +625°F
Spring Temper	900 - 1250	131 - 181	-200° to +330°C	-330° to +625°F
			Note: in both cases slight magnetism may occur below -120°C	Note: in both cases slight magnetism may occur below -184°F

STANDARDS

BS 3075 & 3076 NA 14

AMS 5687

ASTM B166



Inconel 601*

W.NR 2.4851
UNS N06601
AWS 011
* Trade name of Special Metals Group of Companies

A Nickel-Chromium alloy with an addition of aluminium to give outstanding resistance to oxidation and other forms of high temperature corrosion. It also has high mechanical properties at elevated temperatures.

Applications include:
petrochemical processing, industrial furnaces, gas turbine components and for heat treating equipment such as baskets, muffles and retorts.

APPROXIMATE CHEMICAL COMPOSITION

Ni	58 - 63%
Cr	21 - 25%
Fe	BAL
Al	1.0 - 1.7%

DENSITY	8.11 g/cm ³	0.293 lb/in ³
MELTING POINT	1411°C	2571°F
COEFFICIENT OF EXPANSION	13.75 μm/m•°C (20-100°C)	7.6x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	81.2 kN/mm ²	11777 ksi
MODULUS OF ELASTICITY	206.5 kN/mm ²	29951 ksi

CONDITION OF SUPPLY

HEAT TREATMENT (AFTER FORMING)

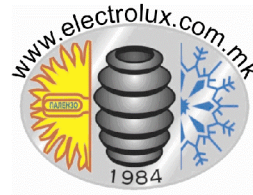
Annealed/Spring Temper

Stress relieve at 480 - 870°C (900 - 1600°F) for 1 hour and air cool.
(temperature depends on composition and amount of cold work)

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	700 - 900 N/mm ²	102 - 131 ksi	-200 to +340°C (for lightly stressed applications)	-330 to +645°F
Spring Temper	1200 - 1450 N/mm ²	174 - 210 ksi	-200 to +340°C (for lightly stressed applications)	-330 to +645°F

STANDARDS

ASTM B166



Inconel 625*

W.NR 2.4856
 UNS N06625
 AWS 012
 * Trade name of Special Metals Group of Companies

A Nickel-Chromium-Molybdenum alloy with excellent corrosion resistance in a wide range of corrosive media, being especially resistant to pitting and crevice corrosion. It is a favourable choice for sea water applications.

Applications include:
 marine and aerospace industries, chemical processing, nuclear reactors and pollution control equipment.

APPROXIMATE CHEMICAL COMPOSITION

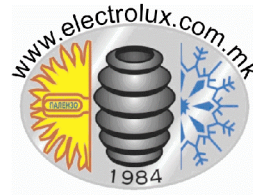
Ni	58% min
Cr	20 - 23%
Mo	8 - 10%
Nb+Ta	3.15 - 4.15%
Fe	5% max

DENSITY	8.44 g/cm ³	0.305 lb/in ³
MELTING POINT	1350°C	2460°F
COEFFICIENT OF EXPANSION	12.8 μm/m•°C (20-100°C)	7.1x10 ⁻⁴ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	79 kN/mm ²	11458 ksi
MODULUS OF ELASTICITY	205.8 kN/mm ²	29849 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 260 - 370°C (500 - 700°F) for 30 - 60 minutes and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	800 - 1000 N/mm ²	116 - 145 ksi	-200° to +340°C	-330° to +645°F
Spring Temper	1300 - 1600 N/mm ²	189 - 232 ksi	up to +200°C	up to +395°F

STANDARDS		
BS 3076 NA 21	ASTM B446	AMS 5666



Inconel 718[®]

W.NR 2.4668
UNS N07718
AWS 013

• Trade name of Special Metals Group of Companies

A Nickel-Chromium alloy being precipitation hardenable and having high creep-rupture strength at high temperatures to about 700°C (1290°F). It has higher strength than Inconel X-750 and better mechanical properties at lower temperatures than Nimonic 90 and Inconel X-750.

Applications include:
gas turbines, rocket motors, space craft,
nuclear reactors and pumps.

APPROXIMATE CHEMICAL COMPOSITION

Ni+Co	50 - 55%
Cr	17 - 21%
Fe	BAL
Nb+Ta	4.75 - 5.5%
Mo	2.8 - 3.3%
Ti	0.65 - 1.15%
Al	0.2 - 0.8%

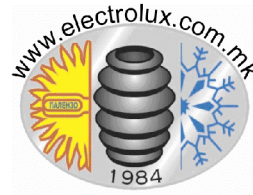
DENSITY	8.19 g/cm ³	0.296 lb/in ³
MELTING POINT	1336°C	2437°F
COEFFICIENT OF EXPANSION	13.0 μm/m•°C (20-100°C)	7.2x10 ⁻⁴ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	77.2 kN/mm ²	11197 ksi
MODULUS OF ELASTICITY	204.9 kN/mm ²	29719 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
No.1 Spring Temper/Spring Temper	1. Solution Anneal at 980°C (1800°F) for 1 hour and air cool and 2. Age harden at 720°C (1330°F) for 8 hours and furnace cool to 620°C (1150°F) and hold at 620°C (1150°F) for a total age hardening time of 18 hours and air cool.
No.1 Spring Temper/Spring Temper (NACE MRO175)	1. 1010°C (1870°F) 2 hours and air cool. and 2. 790°C (1455°F) 6 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	800 - 1000	116 - 145	-	-
No.1 Spring Temper	1000 - 1200	145 - 175	-	-
No.1 Spring Temper + Annealed + Aged	1250 - 1450	181 - 210	-200 to +550°C	-330 to +1020°F
Spring Temper	1300 - 1500	189 - 218	-	-
Spring Temper + Annealed + Aged	1250 - 1450	181 - 210	-200 to +550°C	-330 to +1020°F

STANDARDS

AMS 5663 AMS 5832 AMS 5962 AMS 5662 ASTM B637



Inconel X-750*

W.NR 2.4669
UNS N07750
AWS 014

* Trade name of Special Metals Group of Companies

A Nickel-Chromium alloy made precipitation hardenable by additions of Aluminium and Titanium, having creep-rupture strength at high temperatures to about 700°C (1290°F).

It is widely used for high temperature conditions but is not as strong as Nimonic 90.

Applications include:

nuclear reactors, gas turbines, rocket engines, pressure vessels and aircraft structures.

APPROXIMATE CHEMICAL COMPOSITION

Ni+Co	70% min
Cr	14 - 17%
Fe	5 - 9%
Ti	2.25 - 2.75%
Al	0.4 - 1.0%
Nb+Ta	0.7 - 1.2%

DENSITY		8.28 g/cm ³	0.299 lb/in ³
MELTING POINT		1430°C	2600°F
COEFFICIENT OF EXPANSION		12.6 μm/m • °C (20-100°C)	7.0x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY		75.8 kN/mm ²	10994 ksi
MODULUS OF ELASTICITY	*	218.0 kN/mm ²	31619 ksi
	**	212.4 kN/mm ²	30806 ksi
	***	213.7 kN/mm ²	30995 ksi

* Spring Temper + Aged **Spring Temper + 3 Part Heat Treated *** No.1 Spring Temper + Aged

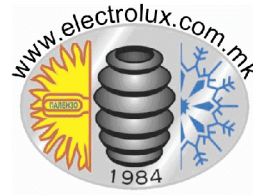
CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Spring Temper	Age harden at 650°C (1200°F) for 4 hours and air cool.
Spring Temper	3 Part Heat Treatment: *1. Solution Anneal at 1150°C (2100°F) for 2 hours and air cool 2. and Stabilise at 843°C (1550°F) for 24 hours and air cool 3. and Age harden at 704°C (1300°F) for 20 hours and air cool.
No.1 Spring temper	Age harden at 730°C (1350°F) for 16 hours and air cool.

*for diameters below 1.00mm contact AWI technical department.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	800 - 1000	116 - 145	-	-
Spring Temper	1100 - 1500	159 - 217	-	-
Spring Temper + Aged	1350 - 1750	196 - 254	-200° up to 370°C	-330° up to 700°F
Spring Temper + 3 Part heat treated	1100 - 1250	159 - 181	-200° up to 550°C	-330° up to 1020°F
No.1 Spring Temper	900 - 1150	130 - 167	-	-
No.1 Spring Temper + Aged	1300 - 1450	188 - 210	-200° up to 550°C	-330° up to 1020°F

STANDARDS

AMS 5667	AMS 5699 (Spring temper)	AMS 5698 (No.1 Spring Temper)	ASTM B637	BS HR 505
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Incoloy 800*

W.NR 1.4875
UNS N08800
AWS 020

* Trade name of Special Metals Group of Companies

This Nickel-Iron-Chromium alloy has good strength and excellent resistance to oxidation and carburisation in high temperature atmospheres.
Incoloy 800 also resists corrosion in many aqueous environments.

Applications include:

process piping, heat exchangers, carburising equipment and heating element sheathing.

APPROXIMATE CHEMICAL COMPOSITION

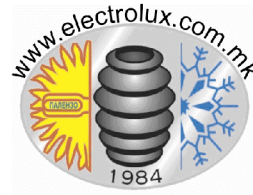
Ni	30 - 35%
Fe	39.5% min
Cr	19 - 23%
C	0.1% max
Al	0.15 - 0.6%
Ti	0.15 - 0.6%

DENSITY	7.94 g/cm ³	0.287 lb/in ³
MELTING POINT	1385°C	2525°F
COEFFICIENT OF EXPANSION	14.4 μm/m • °C (20-100°C)	7.9x10 ⁻⁴ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	78.9 kN/mm ²	11444 ksi
MODULUS OF ELASTICITY	196.5 kN/mm ²	28500 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 450 - 470°C (840 - 880°F) for 30 - 60 minutes and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	600 - 800 N/mm ²	87 - 116 ksi	-200 to +815°C (for lightly stressed applications)	-330 to +1500°F
Spring Temper	800 - 1100 N/mm ²	116 - 159 ksi	-200 to +815°C (for lightly stressed applications)	-330 to +1500°F

STANDARDS
BS 3075 & 3076 NA 15



Incoloy 800HT*

W.NR 1.4958
 W.NR 1.4959
 UNS N08811
 AWS 021
 * Trade name of Special Metals Group of Companies

This Nickel-Chromium-Iron alloy has the same basic composition as Incoloy 800, but has significantly higher creep rupture strength, resultant from the close control of the carbon, aluminium and titanium contents. It has good strength and excellent resistance to oxidation and carburisation in high temperature atmospheres. It also resists corrosion in many aqueous environments.

Applications include:

chemical and petrochemical processing, industrial furnaces and heat treating equipment.

APPROXIMATE CHEMICAL COMPOSITION

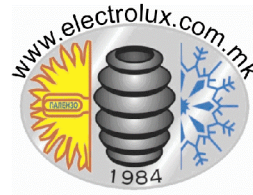
Ni	30 - 35%
Fe	39.5% min
Cr	19 - 23%
C	0.06 - 0.1%
Al	0.15 - 0.6%
Ti	0.15 - 0.6%
Al+Ti	0.85 - 1.2%

DENSITY	7.94 g/cm ³	0.287 lb/in ³
MELTING POINT	1385°C	2525°F
COEFFICIENT OF EXPANSION	14.4 μm/m•°C (20-100°C)	7.9x10 ⁻⁴ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	78.9 kN/mm ²	11444 ksi
MODULUS OF ELASTICITY	196.5 kN/mm ²	28500 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 450 - 470°C (840 - 880°F) for 30 - 60 minutes and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	600 - 800 N/mm ²	87 - 116 ksi	-200° to +1100°C	-330° to +2010°F (for lightly stressed applications)
Spring Temper	800 - 1100 N/mm ²	116 - 159 ksi	-200° to +1100°C	-330° to +2010°F (for lightly stressed applications)

STANDARDS
BS 3076 NA 15H



Incoloy 825^{*}

W.NR 2.4858
UNS N08825
AWS 022

* Trade name of Special Metals Group of Companies

Incoloy 825 is a Nickel-Iron-Chromium alloy with additions of Molybdenum and Copper. It has excellent resistance to both reducing and oxidising acids, to stress-corrosion cracking and to localised pitting and crevice corrosion. It is also especially resistant to sulphuric and phosphoric acids.

Applications include:

chemical processing, nuclear fuel reprocessing, acid production and pickling equipment.

APPROXIMATE CHEMICAL COMPOSITION

Ni	38 - 46%
Fe	22% min
Cr	19.5 - 23.5%
Mo	2.5 - 3.5%
Cu	1.5 - 3%
Ti	0.6 - 1.2%

DENSITY	8.14 g/cm ³	0.294 lb/in ³
MELTING POINT	1400°C	2550°F
COEFFICIENT OF EXPANSION	14.0 μm/m • °C (20-100°C)	7.8x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	75.9 kN/mm ²	11009 ksi
MODULUS OF ELASTICITY	196 kN/mm ²	28428 ksi

CONDITION OF SUPPLY

HEAT TREATMENT (AFTER FORMING)

Annealed/Spring Temper

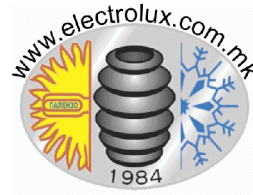
Stress relieve at 450 - 470°C (840 - 880°F) for 30 - 60 minutes and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	600 - 800	87 - 116	-100 to +250	-145 to +480
Spring Temper	800 - 1100	116 - 159	-100 to +250	-145 to +480

STANDARDS

BS 3076 NA 16

ASTM B425



Incoloy A-286

W.NR 1.4944
 W.NR 1.4980
 UNS S66286
 AWS 023
 * Trade name of Special Metals Group of Companies

This age hardenable, Iron-Nickel-Chromium alloy is designed for applications requiring high strength and good corrosion resistance at temperatures up to 700°C (1290°F).

Applications include:
 jet engines, super chargers, after burner parts and fasteners.

APPROXIMATE CHEMICAL COMPOSITION

Fe	56.5%
Ni	25.5%
Cr	15%
Ti	2.1%
Mo	1.25%

DENSITY	7.94 g/cm ³	0.287 lb/in ³
MELTING POINT	1430°C	2600°F
COEFFICIENT OF EXPANSION	16.4 μm/m•°C (20-100°C)	9.1x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	71.5 kN/mm ²	10370 ksi
MODULUS OF ELASTICITY	205 kN/mm ²	29733 ksi

CONDITION OF SUPPLY

HEAT TREATMENT (AFTER FORMING)

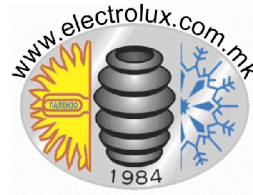
Annealed/Spring Temper

Age Hardened at 705 - 760°C (1300 - 1400°F) for 16 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	600 - 750	87 - 109	-200 to +400	-330 to +750
Annealed + Aged	1100 - 1300	159 - 188	-200 to +400	-330 to +750
Spring Temper	1050 - 1250	152 - 181	-200 to +400	-330 to +750
Spring Temper + Aged	1300 - 1500	188 - 218	-200 to +400	-330 to +750

STANDARDS

AMS 5731 AMS 5734 AMS 5737 AMS 5853 BS HR 650 BS HR 52



Nimonic 90*

W.NR 2.4632
W.NR 2.4969
UNS N07090
AWS 030
* Trade name of Special Metals Group of Companies

A Nickel-Chromium-Cobalt alloy being precipitation hardenable, having high stress-rupture strength and creep resistance at high temperatures up to about 950°C (1740°F). It is widely used and a well proven alloy in high temperature conditions.

Applications include:

aerospace industry, high temperature springs and various thermal processing.

APPROXIMATE CHEMICAL COMPOSITION

Ni	54%
Cr	18 - 21%
Co	15 - 21%
Ti	2 - 3%
Al	1 - 2%

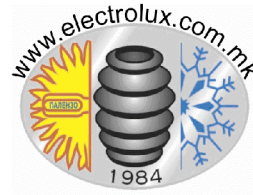
DENSITY		8.18 g/cm ³	0.296 lb/in ³
MELTING POINT		1370°C	2500°F
COEFFICIENT OF EXPANSION		12.7 μm/m • °C (20-100°C)	7.1 x 10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY		82.5 kN/mm ²	11966 ksi
MODULUS OF ELASTICITY	*	213 kN/mm ²	30894 ksi
	**	227 / 240 kN/mm ²	32924 / 34810 ksi

* Solution Annealed + Aged **Spring Temper and Aged

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Solution Annealed	Age Harden at 750°C (1380°F) for 4 hours and air cool.
Spring Temper	Age Harden at 650°C (1200°F) for 4 hours and air cool.
Spring Temper	Age Harden at 600°C (1110°F) for 16 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Solution Annealed	800 - 1000	116 - 145	-	-
Solution Annealed + aged	1300 - 1400	189 - 203	up to 550°C	up to 1020°F
Spring Temper	1300 - 1500	189 - 218	-	-
Spring Temper + aged	1500 - 1800	218 - 261	up to 350°C	up to 660°F

STANDARDS					
BS HR 501 (Spring temper)	BS HR 502 (Solution Annealed)	BS HR 503	BS 3075 NA19	AMS 5829	NCK20TA



Nimonic 80A*

W.NR 2.4952
 W.NR 2.4631
 UNS N07080
 AWS 031
 * Trade name of Special Metals Group of Companies

Nimonic 80A is a Nickel-Chromium alloy which is precipitation hardenable. It has largely been superseded by Nimonic 90 and Inconel X-750, but because of the low Cobalt content, it is still specified for nuclear applications.

Applications include:
 gas turbine components, nuclear industry and fasteners.

APPROXIMATE CHEMICAL COMPOSITION

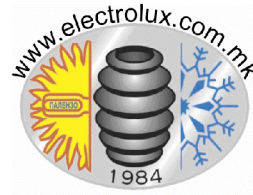
Cr	18 - 21%
Ti	1.8 - 2.7%
Al	1.0 - 1.80%
Co	2% max
Ni	BAL

DENSITY	8.19 g/cm ³	0.296 lb/in ³
MELTING POINT	1365°C	2490°F
COEFFICIENT OF EXPANSION	12.7 μm/m • °C (20-100°C)	7.1x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	85 kN/mm ²	12328 ksi
MODULUS OF ELASTICITY	222 kN/mm ²	32199 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Solution Annealed	Age Harden at 700°C (1290°F) for 16 hours and air cool.
Spring Temper	Age Harden at 600°C (1110°F) for 16 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Solution Annealed	800 - 1000 N/mm ²	116 - 145 ksi	-	-
Solution Annealed + Aged	1200 - 1400 N/mm ²	174 - 203 ksi	up to 550°C	up to 1020°F
Spring Temper	1300 - 1500 N/mm ²	189 - 218 ksi	-	-
Spring Temper + Aged	1500 - 1800 N/mm ²	218 - 261 ksi	up to 350°C	up to 660°F

STANDARDS		
BS HR 601	BS 3076 NA 20	ASTM B637



Nimonic 75[•]

W.NR 2.4951
 W.NR 2.4630
 UNS N06075
 AWS 032
 • Trade name of Special Metals Group of Companies

Nimonic 75 is a Nickel-Chromium alloy with good corrosion and heat resistance.

Applications include:
 aerospace fasteners.

APPROXIMATE CHEMICAL COMPOSITION

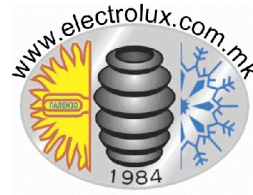
Ni 80% min
 Cr 19.5%

DENSITY	8.37 g/cm ³	0.302 lb/in ³
MELTING POINT	1380°C	2520°F
COEFFICIENT OF EXPANSION	11.0 μm/m • °C (20-100°C)	6.1 x 10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	75.6 kN/mm ²	10965 ksi
MODULUS OF ELASTICITY	206 kN/mm ²	29878 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 450 - 470°C (840 - 880°F) for 30 - 60 minutes and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Solution Annealed	700 - 800 N/mm ²	102 - 116 ksi	-200 to +1100°C (for lightly stressed applications)	-330 to +2010°F
Cold Drawn	1200 - 1500 N/mm ²	174 - 218 ksi	-200 to +1100°C (for lightly stressed applications)	-330 to +2010°F

STANDARDS	
BS HR 5	BS HR 504



Monel 400[®]

W.NR 2.4360
 W.NR 2.4361
 UNS N04400
 AWS 040
 • Trade name of Special Metals Group of Companies

A Nickel-Copper alloy with high strength and excellent corrosion resistance in a range of acidic and alkaline environments and especially suitable for reducing conditions. It also has good ductility and thermal conductivity.

Applications include:

marine engineering, chemical and hydro-carbon processing equipment, heat exchangers, valves and pumps.

APPROXIMATE CHEMICAL COMPOSITION

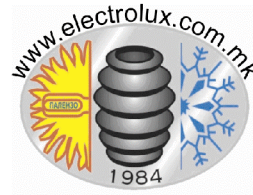
Ni	63%
Cu	28 -34%
Fe	2.5% max
Mn	2% max

DENSITY	8.8 g/cm ³	0.318 lb/in ³
MELTING POINT	1350°C	2460°F
COEFFICIENT OF EXPANSION	13.9 μm/m•°C (20-100°C)	7.7x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	65.3 kN/mm ²	9471 ksi
MODULUS OF ELASTICITY	173 kN/mm ²	25092 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 300 - 320°C (570 - 610°F) for 30 - 60 minutes and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	400 - 600 N/mm ²	58 - 87 ksi	-200 to +230°C	-330 to +445°F
Spring Temper	850 - 1050 N/mm ²	123 - 152 ksi	-200 to +230°C	-330 to +445°F

STANDARDS		
BS 3075 & 3076 NA 13	DTD 204B	ASTM B164



Monel K-500*

W.NR 2.4375
UNS N05500
AWS 041

* Trade name of Special Metals Group of Companies

This Nickel-Copper alloy is precipitation hardenable, due to the additions of Aluminium and Titanium. It combines the corrosion resistance of Monel 400 but gives the added advantage of extra strength and hardness (as a result of its age hardening ability).

Applications include:

pump shafts, fasteners, marine propeller shafts, oil well tools, instruments and springs.

**APPROXIMATE
CHEMICAL COMPOSITION**

Ni	63% min
Cu	30%
Fe	2% max
Al	2.3 - 3.15%
Ti	0.35 - 0.85%

DENSITY	8.44 g/cm ³	0.305 lb/in ³
MELTING POINT	1350°C	2460°F
COEFFICIENT OF EXPANSION	13.7 μm/m • °C (20-100°C)	7.6x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	66 kN/mm ²	9573 ksi
MODULUS OF ELASTICITY	179 kN/mm ²	25962 ksi

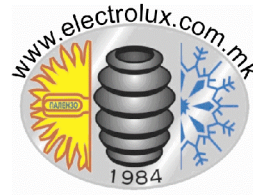
CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed	Age harden at 580 - 590°C (1075 - 1095°F) for 8 - 10 hours and air cool.*
Spring Temper	Age harden at 530 - 550°C (985 - 1020°F) for 4 - 6 hours and furnace cool to 450°C (840°F) at a rate of 8 -15°C (45-60°F) per hour and air cool.*
Spring Temper	Age harden at 530 - 540°C (985-1005°F) for 4 - 6 hours and air cool.*

* heat treating Monel K-500 in free air can have a detrimental effect on its corrosion resistant properties.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	650 - 850	94 - 123	-100 to +260	-150 to +500
Annealed + Aged	950 - 1050	138 - 167	-100 to +260	-150 to +500
Spring Temper	1000 - 1300	145 - 189	-110 to +260	-150 to +500
Spring Temper + Aged	1200 - 1500	174 - 218	-100 to +260	-150 to +500

STANDARDS

BS 3075 & 3076 NA 18



Hastelloy B-2⁺

W.NR 2.4617
UNS N10665
AWS 050

⁺ Trade name of Haynes International

Hastelloy B-2 is a Nickel base wrought alloy with excellent resistance to hydrochloric acid at all concentrations and temperatures. B-2 also withstands hydrogen chloride, sulphuric, hydrofluoric, acetic and reagent grade phosphoric acids. This alloy also has excellent resistance to stress corrosion cracking and to knife line and heat affected zone attack.

Applications include:
chemical processing
(not recommended in the presence of ferric or cupric salts)

APPROXIMATE CHEMICAL COMPOSITION

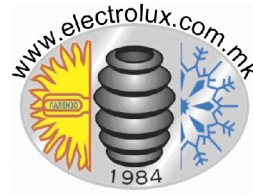
Ni	69%
Mo	28%
Fe	2% max
Cr	1% max
Co	1% max

DENSITY	9.22 g/cm ³	0.333 lb/in ³
MELTING POINT	1370°C	2500°F
COEFFICIENT OF EXPANSION	10.3 μm/m•°C (20-100°C)	5.7x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	84 kN/mm ²	12183 ksi
MODULUS OF ELASTICITY	217 kN/mm ²	31474 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	900 - 1100 N/mm ²	131 - 159 ksi	-200° to +400°C	-330° to +750°F
Spring Temper	1400 - 1900 N/mm ²	203 - 276 ksi	-200° to +400°C	-330° to +750°F

STANDARDS	
ASTM B335	ASTM B619



Hastelloy B-3[^]

W.NR 2.4600
UNS N10675
AWS 051

[^] Trade name of Haynes International

This Nickel-Molybdenum alloy gives excellent resistance to hydrochloric acid at all concentrations and temperatures. It also withstands sulphuric, acetic, formic and phosphoric acids and other non oxidizing media. B-3 also has excellent resistance to pitting corrosion and to stress-corrosion cracking.

Applications include:
chemical processing
(not recommended in the presence of ferric or cupric salts)

APPROXIMATE CHEMICAL COMPOSITION

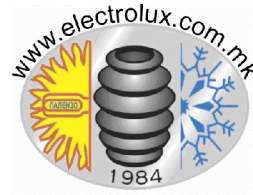
Ni	65% min
Mo	28.5%
Cr	1.5%
Fe	1.5%
Co	3% max
W	3% max
Mn	3% max

DENSITY	9.22 g/cm ³	0.333 lb/in ³
MELTING POINT	1418°C	2585°F
COEFFICIENT OF EXPANSION	10.6 μm/m•°C (20-100°C)	5.7x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	83 kN/mm ²	12038 ksi
MODULUS OF ELASTICITY	216 kN/mm ²	31329 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	1000 - 1200 N/mm ²	145 - 174 ksi	-200 to +400°C	-330 to +750°F
Spring Temper	1600 - 2000 N/mm ²	232 - 290 ksi	-200 to +400°C	-330 to +750°F

STANDARDS	
ASTM B335	ASTM B619



Hastelloy C-4 [▲]

W.NR 2.4610
UNS N06455
AWS 052

[▲] Trade name of Haynes International

This Nickel-Chromium-Molybdenum alloy tolerates high temperatures and gives a design freedom in areas where weld geometry makes excessive heat build-up unavoidable. Resistance to general and localised corrosion and stress corrosion cracking is generally similar to Hastelloy C-276.

Applications include:
chemical processing.

APPROXIMATE CHEMICAL COMPOSITION

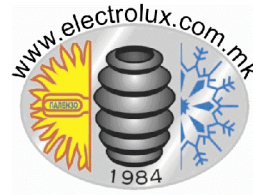
Ni	65%
Cr	16%
Mo	16%
Fe	3% max
Co	2% max

DENSITY	8.64 g/cm ³	0.312 lb/in ³
MELTING POINT	1399°C	2550°F
COEFFICIENT OF EXPANSION	10.8 μm/m • °C (20-100°C)	6.0x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	81.2 kN/mm ²	11777 ksi
MODULUS OF ELASTICITY	212.4 kN/mm ²	30807 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	Annealed	800 - 1100 N/mm ²	116 - 159 ksi	-200 to +400°C
Spring Temper	1300 - 1500 N/mm ²	189 - 218 ksi	-200 to +400°C	-330 to +750°F

STANDARDS	
ASTM B574	ASTM B619



Hastelloy C-22 [▲]

W.NR 2.4602
UNS N06022
AWS 053

[▲] Trade name of Haynes International

A Nickel-Chromium-Molybdenum alloy with better overall corrosion resistance and versatility than any other NiCrMo available. It has excellent resistance to localised corrosion and to a variety of mixed industrial chemicals.

Applications include:

chlorination systems, nuclear fuel reprocessing and pickling systems.

APPROXIMATE CHEMICAL COMPOSITION

Ni	56%
Cr	22%
Mo	13%
Co	2.5% max
W	3%
Fe	3%

DENSITY	8.69 g/cm ³	0.314 lb/in ³
MELTING POINT	1399°C	2550°F
COEFFICIENT OF EXPANSION	12.4 μm/m•°C (20-100°C)	6.9x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	78.6 kN/mm ²	11400 ksi
MODULUS OF ELASTICITY	205.5 kN/mm ²	29806 ksi

CONDITION OF SUPPLY

HEAT TREATMENT (AFTER FORMING)

Annealed/Spring Temper

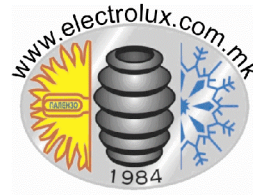
Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	800 - 1100 N/mm ²	116 - 159 ksi	-200 to +400°C	-330 to +750°F
Spring Temper	1400 - 1700 N/mm ²	203 - 247 ksi	-200 to +400°C	-330 to +750°F

STANDARDS

ASTM B619

ASTM B574



Hastelloy C-276[▲]

W.NR 2.4819
UNS N10276
AWS 054

[▲] Trade name of Haynes International

This Nickel-Molybdenum-Chromium alloy with the addition of Tungsten, has excellent corrosion resistance in a wide range of corrosive media and is especially resistant to pitting and crevice corrosion.

Applications include:

pollution control, chemical processing, waste treatment, marine engineering, pulp and paper production.

APPROXIMATE CHEMICAL COMPOSITION

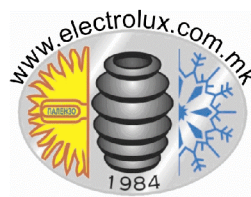
Ni	55%
Mo	15 - 17%
Cr	14.5 - 16.5%
Fe	4 - 7%
W	3 - 4.5%

DENSITY	8.89 g/cm ³	0.321 lb/in ³
MELTING POINT	1370°C	2500°F
COEFFICIENT OF EXPANSION	11.2 μm/m • °C (20-100°C)	6.2x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	78.6 kN/mm ²	11400 ksi
MODULUS OF ELASTICITY	205.5 kN/mm ²	29806 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	850 - 1050 N/mm ²	123 - 152 ksi	-200 to +400°C	-330 to +750°F
Spring Temper	1300 - 1600 N/mm ²	189 - 232 ksi	-200 to +400°C	-330 to +750°F

STANDARDS	
ASTM B619	ASTM B574



Hastelloy C-2000 [▲]

W.NR 2.4675
UNS N06200
AWS 055

[▲] Trade name of Haynes International

This alloy was developed to broaden the application range of one alloy. With the addition of Copper to the Nickel-Chromium-Molybdenum system, Hastelloy C-2000 is resistant to an extensive range of corrosive chemicals, including sulphuric, hydrochloric and hydrofluoric acids. The combination of Molybdenum and Copper provide excellent corrosion resistance to reducing media, while the high Chromium content gives good oxidising resistance.

Applications include:
chemical processing.

APPROXIMATE CHEMICAL COMPOSITION

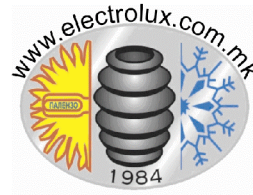
Ni	59%
Cr	23%
Mo	16%
Cu	1.6%

DENSITY	8.5 g/cm ³	0.307 lb/in ³
MELTING POINT	1399°C	2550°F
COEFFICIENT OF EXPANSION	12.4 μm/m • °C (20-100°C)	6.9x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	79 kN/mm ²	11458 ksi
MODULUS OF ELASTICITY	206 kN/mm ²	29878 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	700 - 1000 N/mm ²	102 - 145 ksi	-200 to +400°C	-330 to +750°F
Spring Temper	1300 - 1600 N/mm ²	189 - 232 ksi	-200 to +400°C	-330 to +750°F

STANDARDS	
ASTM B619	ASTM B574



Hastelloy G-30[▲]

W.NR 2.4603
UNS N06030
AWS 056

▲ Trade name of Haynes International

G-30 is a high Nickel based alloy which shows superior corrosion resistance over most other Nickel and Iron based alloys in phosphoric acids as well as many complex environments containing highly oxidising acids such as nitric, hydrofluoric and sulphuric acids.

Applications include:

nuclear fuel reprocessing, nuclear waste processing, pickling operations and petrochemical processing.

APPROXIMATE CHEMICAL COMPOSITION

Ni	43%
Cr	28 - 31.5%
Fe	13 - 17%
Mo	4 - 6%
Co	5% max
W	1.5 - 4%

DENSITY	8.22 g/cm ³	0.297 lb/in ³
MELTING POINT	1399°C	2550°F
COEFFICIENT OF EXPANSION	12.8 μm/m • °C (20-100°C)	7.1x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	77.6 kN/mm ²	11255 ksi
MODULUS OF ELASTICITY	202 kN/mm ²	29298 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
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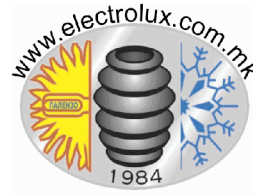
Annealed/Spring Temper

Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

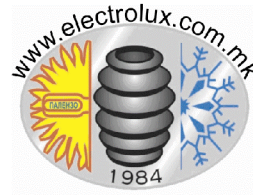
CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	650 - 900	94 - 131	-200 to +400	-330 to +750
Spring Temper	1000 - 1500	145 - 218	-200 to +400	-330 to +750

STANDARDS

ASTM B619



<h1>Hastelloy X [▲]</h1> <p>Hastelloy X is a Nickel-Chromium-Iron-Molybdenum alloy with an exceptional combination of oxidation resistance, ease of fabrication and high temperature strength. It has also been found to be exceptionally resistant to stress corrosion cracking in petrochemical applications.</p> <p><u>Applications include:</u> gas turbine engine components, industrial furnace applications, chemical processing and petrochemical industry.</p>		W.NR 2.4665 UNS N06002 AWS 057 <small>▲ Trade name of Haynes International</small>	
		APPROXIMATE CHEMICAL COMPOSITION	
		Ni	47%
		Cr	22%
		Fe	18%
		Mo	9%
		Co	1.5%
DENSITY		8.22 g/cm ³	0.297 lb/in ³
MELTING POINT		1355°C	2470°F
COEFFICIENT OF EXPANSION		13.9 μm/m•°C (20-100°C)	7.7x10 ⁻⁴ in/in•°F (70-212°F)
MODULUS OF RIGIDITY		77.6 kN/mm ²	11255 ksi
MODULUS OF ELASTICITY		205 kN/mm ²	29733 ksi
CONDITION OF SUPPLY		HEAT TREATMENT (AFTER FORMING)	
Annealed/Spring Temper		Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.	
CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE
Annealed	850 - 1050 N/mm ²	123 - 152 ksi	-200 to +400°C -330 to +750°F
Spring Temper	1350 - 1550 N/mm ²	196 - 225 ksi	-200 to +400°C -330 to +750°F
STANDARDS			
AMS 5798		ASTM B619	



Haynes 25 [▲]

W.NR 2.4964
UNS R30605
AWS 060

[▲] Trade name of Haynes International

Haynes 25 is a Cobalt-Nickel-Chromium-Tungsten alloy that combines excellent high temperature strength with good resistance to oxidising environments up to 980°C (1795°F) for long exposures. It also has excellent resistance to sulphidation.

Applications include:
parts in gas turbine engines and bearings.

APPROXIMATE CHEMICAL COMPOSITION

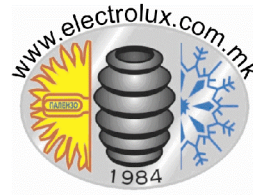
Co	51 % max
Cr	20%
W	15%
Ni	10%
Fe	3% max
Mn	1.5%

DENSITY	9.13 g/cm ³	0.330 lb/in ³
MELTING POINT	1410°C	2570°F
COEFFICIENT OF EXPANSION	12.3 μm/m • °C (20-100°C)	6.8x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	98 kN/mm ²	14214 ksi
MODULUS OF ELASTICITY	225 kN/mm ²	32634 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	950 - 1100 N/mm ²	138 - 159 ksi	-200°C to +900°C	-330°F to +1650°F (for lightly stressed applications)
Spring Temper	1400 - 1800 N/mm ²	203 - 261 ksi	-200°C to +900°C	-330°F to +1650°F (for lightly stressed applications)

STANDARDS	
AMS 5796	ASTM F90



Haynes 214⁺

W.NR 2.4646
UNS N07214
AWS 061

▲ Trade name of Haynes International

Haynes 214 is a Nickel-Chromium-Aluminium-Iron alloy which is principally intended for use at temperatures of 955°C (1750°F) and above. It exhibits resistance to oxidation that far exceeds virtually all conventional heat resistant wrought alloys at these temperatures.

Applications include:

mesh belts, trays and fixtures for the firing of pottery and china and the heat treatment of electronic devices and technical grade ceramics.

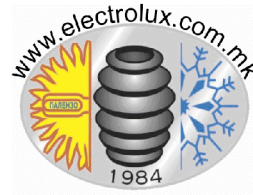
APPROXIMATE CHEMICAL COMPOSITION

Ni	75%
Cr	16%
Al	4.5%
Fe	3%
Mn	0.5% max

DENSITY	8.05 g/cm ³	0.291 lb/in ³
MELTING POINT	1400°C	2550°F
COEFFICIENT OF EXPANSION	13.3 μm/m•°C (20-100°C)	7.4x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	84 kN/mm ²	12183 ksi
MODULUS OF ELASTICITY	217 kN/mm ²	31474 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed/Spring Temper	Stress relieve at 400 - 450°C (750 - 840°F) for 2 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	900 - 1050 N/mm ²	131 - 152 ksi	-200 to +1100°C (for lightly stressed applications)	-330 to +2010°F
Spring Temper	1300 - 1700 N/mm ²	189 - 247 ksi	-200 to +1100°C (for lightly stressed applications)	-330 to +2010°F



Nickel 200*

W.NR 2.4060
W.NR 2.4066
UNS N02200
AWS 070
* Trade name of Special Metals Group of Companies

Nickel 200 is commercially pure and has good mechanical properties and excellent corrosion resistance to alkalis i.e. Sodium hydroxide. It also has good electrical, thermal and magneto-strictive properties.

Applications include:
food and synthetic fibre processing, heat exchangers, chemical and electrical industries.

APPROXIMATE CHEMICAL COMPOSITION	
Ni	99% min (Typically 99.6% Nickel)

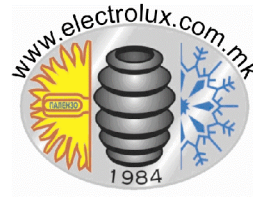
DENSITY	8.89 g/cm ³	0.321 lb/in ³
MELTING POINT	1446°C	2635°F
COEFFICIENT OF EXPANSION	13.3 μm/m•°C (20-100°C)	7.4x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	81 kN/mm ²	11748 ksi
MODULUS OF ELASTICITY	204 kN/mm ²	29588 ksi

ELECTRICAL RESISTIVITY	
9.6 μΩ•cm	58 ohm•circ mil/ft

THERMAL CONDUCTIVITY	
70.2 W/m•°C	487 btu•in/ft ² •h•°F

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE
Annealed	400 - 500 N/mm ²	58 - 73 ksi	Tensile strength and elongation drop significantly at temperatures above 315°C (600°F). Service temperature is dependent on environment, load and size range.
Hard Drawn	700 - 900 N/mm ²	102 - 131 ksi	

STANDARDS		
BS 3075 & 3076 NA11	ASTM B160	ASTM B162



Nickel 201*

W.NR 2.4061
 W.NR 2.4068
 UNS N02201
 AWS 071
 * Trade name of Special Metals Group of Companies

A commercially pure Nickel (typically 99.6% Nickel), Nickel 201 is essentially the same as Nickel 200, but with a lower Carbon content to prevent embrittlement by inter granular carbon at temperatures over 315°C (600°F). Lower carbon content also reduces hardness.

Applications include:

food and synthetic fibre processing, heat exchangers, chemical and electrical industries.

APPROXIMATE CHEMICAL COMPOSITION

Ni 99% min
 C 0.02% max

DENSITY	8.89 g/cm ³	0.321 lb/in ³
MELTING POINT	1446°C	2635°F
COEFFICIENT OF EXPANSION	13.1 μm/m•°C (20-100°C)	7.3x10 ⁻⁴ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	82 kN/mm ²	11893 ksi
MODULUS OF ELASTICITY	207 kN/mm ²	30000 ksi

ELECTRICAL RESISTIVITY

8.5 μΩ•cm

51 ohm•circ mil/ft

THERMAL CONDUCTIVITY

79.3 W/m•°C

550 btu•in/ft²•h•°F

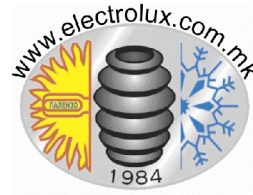
CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE
Annealed	400 - 500 N/mm ²	58 - 73 ksi	Tensile strength and elongation drop significantly at temperatures above 315°C (600°F). Service temperature is dependent on environment, load and size range.
Hard Drawn	700 - 900 N/mm ²	102 - 131 ksi	

STANDARDS

BS 3076 NA12

ASTM B160

ASTM B162



Nickel 205 *

W.NR 2.4061
UNS N02205
AWS 072

* Trade name of Special Metals Group of Companies

Nickel 205 is similar to Nickel 200, but has compositional adjustments to enhance its performance in electrical and electronic applications.

Applications include:

anodes and grids of electronic valves, lead wires, transistor housings and magneto-strictive transducers.

APPROXIMATE CHEMICAL COMPOSITION

Ni	99% min
Mg	0.01 - 0.08%
Ti	0.01 - 0.05%

DENSITY	8.89 g/cm ³	0.321 lb/in ³
MELTING POINT	1446°C	2635°F
COEFFICIENT OF EXPANSION	13.3 μm/m•°C (20-100°C)	7.4x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	82 kN/mm ²	11893 ksi
MODULUS OF ELASTICITY	207 kN/mm ²	30000 ksi

ELECTRICAL RESISTIVITY

9.5 μΩ•cm

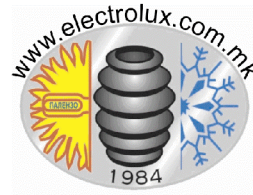
57 ohm•circ mil/ft

THERMAL CONDUCTIVITY

75 W/m•°C

520 btu•in/ft²•h•°F

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE
Annealed	400 - 500 N/mm ²	58 - 73 ksi	Tensile strength and elongation drop significantly at temperatures above 315°C (600°F). Service temperature is dependent on environment, load and size range.
Hard drawn	700 - 900 N/mm ²	102 - 131 ksi	



Nickel 212*

W.NR 2.4110
AWS 073

* Trade name of Special Metals Group of Companies

Nickel strengthened with an addition of Manganese.

Applications include:

electrical lead wires, supporting components in lamps and cathode ray tubes, electrodes in glow-discharge lamps and sparking contacts.

APPROXIMATE CHEMICAL COMPOSITION

Ni	97% min
Mn	1.5 - 2.5%

DENSITY	8.86 g/cm ³	0.320 lb/in ³
MELTING POINT	1446°C	2635°F
COEFFICIENT OF EXPANSION	12.9 μm/m•°C (20-100°C)	7.2x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	78 kN/mm ²	11313 ksi
MODULUS OF ELASTICITY	196 kN/mm ²	28400 ksi

ELECTRICAL RESISTIVITY

10.9 μΩ•cm

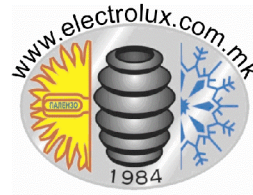
66 ohm•circ mil/ft

THERMAL CONDUCTIVITY

44 W/m•°C

305 btu•in/ft²•h•°F

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE
Annealed	450 - 550 N/mm ²	65 - 80 ksi	Tensile strength and elongation drop significantly at temperatures above 315°C (600°F).
Hard Drawn	750 - 950 N/mm ²	109 - 138 ksi	Service temperature is dependent on environment, load and size range.



Nickel 270*

W.NR 2.4050
UNS N02270
AWS 074

* Trade name of Special Metals Group of Companies

A high purity grade of nickel that is made by powder metallurgy.

Applications include:

electrical resistance thermometers and various other electrical and electronic applications.

APPROXIMATE CHEMICAL COMPOSITION

Ni 99.9% min

DENSITY	8.89 g/cm ³	0.321 lb/in ³
MELTING POINT	1454°C	2650°F
COEFFICIENT OF EXPANSION	13.3 μm/m•°C (20-100°C)	7.4x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	82 kN/mm ²	11893 ksi
MODULUS OF ELASTICITY	207 kN/mm ²	30000 ksi

ELECTRICAL RESISTIVITY

7.5 μΩ•cm

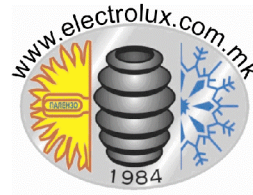
45 ohm•circ mil/ft

THERMAL CONDUCTIVITY

86 W/m•°C

595 btu•in/ft²•h•°F

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE
Annealed	300 - 450 N/mm ²	44 - 65 ksi	Tensile strength and elongation drop significantly at temperatures above 315°C (600°F).
Hard Drawn	600 - 800 N/mm ²	87 - 116 ksi	Service temperature is dependent on environment, load and size range.



Ni-Span-C Alloy 902

UNS N09902
AWS 080

• Trade name of Special Metals Group of Companies

A precipitation hardenable Nickel-Iron-Chromium alloy having outstanding controllable thermoelastic coefficient characteristics and excellent strength and oxidation resistance in high temperature atmospheres. The alloy can be processed to have a constant modulus of elasticity at temperatures ranging from -45°C to +65°C (-50 to +150°F).

Applications include:

springs in precise applications, such as watches and weighing machines

APPROXIMATE CHEMICAL COMPOSITION

Ni	41 - 43.5%
Cr	4.9 - 5.75%
Ti	2.2 - 2.75%
Fe	48%

DENSITY	8.05 g/cm ³	0.291 lb/in ³
MELTING POINT	1480°C	2700°F
COEFFICIENT OF EXPANSION	7.6 μm/m•°C (20-100°C)	4.2x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	62 - 69 kN/mm ²	8993 - 10008 ksi
MODULUS OF ELASTICITY	165 - 200 kN/mm ²	23932 - 29008 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
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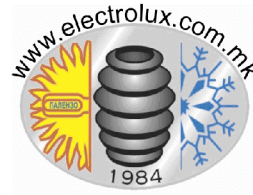
Spring Temper For good all round properties:	Age harden at 650°C (1200°F) for 2 hours and air cool.
For maximum stability:	Stress equalise at 400°C (750°F) for 2 hours and air cool and age harden at 650°C (1200°F) for 2 hours and air cool.
For min. hysteresis & low thermo elastic coefficient:	Stress equalise at 400°C (750°F) for 2 hours and air cool.

(Very high precision applications will require each batch to be pilot tested to determine the specific heat treatment necessary to produce the required thermo elastic coefficient).

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	Annealed	450 - 650 N/mm ²	65 - 94 ksi	-45 to +65°C (for constant modulus applications)
Spring Temper	900 - 1100 N/mm ²	131 - 159 ksi	-45 to +65°C (for constant modulus applications)	-50 to +150°F
Spring Temper+ Aged	1300 - 1500 N/mm ²	189 - 218 ksi	-45 to +65°C (for constant modulus applications)	-50 to +150°F

STANDARDS

AMS 5225



Nilo 36[•]

W.NR 1.3912
 UNS K93600
 UNS K93601
 AWS 090
 • Trade name of Special Metals Group of Companies

A Nickel-Iron, low expansion alloy containing 36% Nickel. It maintains near constant dimensions over the range of normal atmospheric temperatures and has a low coefficient of expansion from cryogenic temperatures to about 500°C (930°F). Nilo 36 also retains good strength and toughness at cryogenic temperatures.

Applications include:

standards of length, thermostat rods, laser components, tanks and piping for the storage and transportation of liquefied gasses.

APPROXIMATE CHEMICAL COMPOSITION

Ni 35 - 38%

Fe BAL

DENSITY		8.11 g/cm ³	0.293 lb/in ³
MELTING POINT		1430°C	2610°F
INFLECTION POINT		220°C	430°F
THERMAL CONDUCTIVITY		10.0 W/m•°C	69.3 btu•in/ft ² •h•°F
COEFFICIENT OF EXPANSION		1.5 μm/m•°C (20-100°C)	0.83x10 ⁻⁶ in/in•°F (70-212°F)
		2.6 μm/m•°C (20-200°C)	1.4x10 ⁻⁶ in/in•°F (70-392°F)

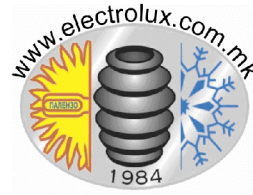
HEAT TREATMENT (AFTER FORMING)

The Nilo alloys are usually used in the annealed condition (residual cold work distorts the coefficients of thermal expansion).
 Anneal at 850 - 1000°C (1560 - 1830°F)

For highest dimensional stability, heat treat as follows:

Anneal at 830°C (1525°F) for 30 minutes and water quench,
 Re-heat to 300°C (570°F) for 1 hour and water quench.
 Finally re-heat to 100°C (212°F) for 48 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	Annealed	450 - 550 N/mm ²	65 - 80 ksi	up to 500°C
Hard Drawn	700 - 900 N/mm ²	102 - 131 ksi	up to 500°C	up to 930°F



Nilo 42[•]

W.NR 1.3917
UNS K94100
AWS 091

[•] Trade name of Special Metals Group of Companies

A Nickel-Iron, low expansion alloy containing 42% Nickel. It has a low and nominally constant coefficient of thermal expansion from room temperature to about 300°C (570°F).

Applications include:

semiconductor lead frames, thermostat rods, various glass to metal seals.

APPROXIMATE CHEMICAL COMPOSITION

Ni 42%
Fe BAL

DENSITY	8.11 g/cm ³	0.293 lb/in ³
MELTING POINT	1435°C	2615°F
INFLECTION POINT	370°C	700°F
THERMAL CONDUCTIVITY	10.5 W/m•°C	72.8 btu•in/ft ² •h•°F
COEFFICIENT OF EXPANSION	5.3 μm/m•°C (20-100°C)	2.9x10 ⁻⁶ in/in•°F (70-212°F)
	4.5 - 6.5 μm/m•°C (20-300°C)	2.5 - 3.6x10 ⁻⁶ in/in•°F (70-572°F)

HEAT TREATMENT (AFTER FORMING)

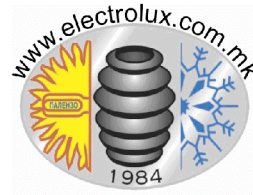
The Nilo alloys are usually used in the annealed condition (residual cold work distorts the coefficients of thermal expansion).

Anneal at 850 - 1000°C (1560 - 1830°F)

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	Annealed	450 - 550 N/mm ²	65 - 80 ksi	up to 300°C
Hard Drawn	700 - 900 N/mm ²	102 - 131 ksi	up to 300°C	up to 570°F

STANDARDS

ASTM F30



Nilo 48*

W.NR 1.3922
W.NR 1.3926
W.NR 1.3927
UNS K94800
AWS 092

* Trade name of Special Metals Group of Companies

A Nickel-Iron, controlled expansion alloy containing 48% Nickel. Its coefficient of thermal expansion was designed to match that of soft lead and soda-lime glasses. This alloy also has a high inflection point.

Applications include:

industrial thermostats that operate at temperatures up to 450°C (840°F) and various glass to metal seals.

APPROXIMATE CHEMICAL COMPOSITION

Ni 48%
Fe BAL

DENSITY	8.2 g/cm ³	0.296 lb/in ³
MELTING POINT	1450°C	2640°F
INFLECTION POINT	460°C	860°F
THERMAL CONDUCTIVITY	16.7 W/m•°C	116 btu•in/ft ² •h•°F
COEFFICIENT OF EXPANSION	8.5 μm/m•°C (20-100°C)	4.7x10 ⁻⁶ in/in•°F (70-212°F)
	8.3 - 9.3 μm/m•°C (20-400°C)	4.6 - 5.2x10 ⁻⁶ in/in•°F (70-572°F)

HEAT TREATMENT (AFTER FORMING)

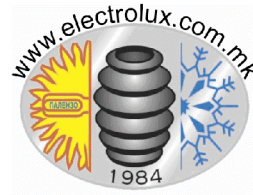
The Nilo alloys are usually used in the annealed condition (residual cold work distorts the coefficients of thermal expansion).

Anneal at 850 - 1000°C (1560 - 1830°F)

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	450 - 550 N/mm ²	65 - 80 ksi	up to 450°C	up to 840°F
Hard Drawn	700 - 900 N/mm ²	102 - 131 ksi	up to 450°C	up to 840°F

STANDARDS

ASTM F30



Nilo 52 °

W.NR 2.4478
UNS N14052
AWS 093

• Trade name of Special Metals Group of Companies

Nilo 52 was designed for use with a variety of soft glasses. It is known for its almost constant coefficient of thermal expansion up to approx. 565°C (1050°F).

Applications include:

various glass to metal sealing applications with soft glass and ceramics.

APPROXIMATE CHEMICAL COMPOSITION

Ni 52%
Fe BAL

DENSITY	8.3 g/cm ³	0.300 lb/in ³
MELTING POINT	1450°C	2640°F
INFLECTION POINT	500°C	930°F
THERMAL CONDUCTIVITY	17 W/m•°C	118 btu•in/ft ² •h•°F
COEFFICIENT OF EXPANSION	10.3 μm/m•°C (20-100°C)	5.7x10 ⁻⁶ in/in•°F (70-212°F)

HEAT TREATMENT (AFTER FORMING)

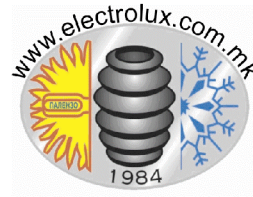
The Nilo alloys are usually used in the annealed condition (residual cold work distorts the coefficients of thermal expansion).

Anneal at 850 - 1000°C (1560 - 1830°F)

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	Annealed	450 - 550 N/mm ²	65 - 80 ksi	up to 450°C
Hard Drawn	700 - 900 N/mm ²	102 - 131 ksi	up to 450°C	up to 840°F

STANDARDS

ASTM F30



Nilo K *

W.NR 1.3981
UNS K94610
AWS 094

* Trade name of Special Metals Group of Companies

A Nickel-Iron-Cobalt, controlled expansion alloy containing 29% Nickel. Its coefficient of expansion (which decreases with rising temperature to the inflection point), matches the expansion rate of borosilicate glasses and alumina ceramics.

Applications include:

glass to metal seals in applications requiring high reliability or resistance to thermal shock, ie. high power transmitting valves.

APPROXIMATE CHEMICAL COMPOSITION

Ni	29%
Fe	53%
Co	17%

DENSITY	8.16 g/cm ³	0.295 lb/in ³
MELTING POINT	1450°C	2640°F
INFLECTION POINT	450°C	840°F
THERMAL CONDUCTIVITY	16.7 W/m•°C	116 btu•in/ft ² •h•°F
COEFFICIENT OF EXPANSION	6.0 μm/m•°C (20-100°C)	3.3x10 ⁻⁶ in/in•°F (70-212°F)
	4.6 - 5.2 μm/m•°C (20-400°C)	2.6 - 2.9x10 ⁻⁶ in/in•°F (70-752°F)

HEAT TREATMENT (AFTER FORMING)

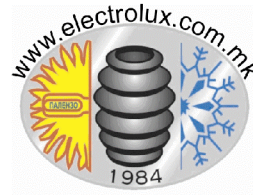
The Nilo alloys are usually used in the annealed condition (residual cold work distorts the coefficients of thermal expansion).

Anneal at 850 - 1000°C (1560 - 1830°F)

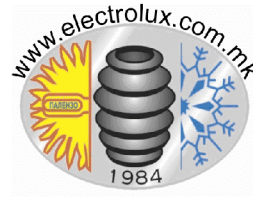
CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	Annealed	450 - 550 N/mm ²	65 - 80 ksi	up to 400°C
Hard Drawn	700 - 900 N/mm ²	102 - 131 ksi	up to 400°C	up to 750°F

STANDARDS

ASTM F15



<h1>Phynox[†]</h1>		W.NR 2.4711		
		UNS R30003		
		AWS 100		
		† Trade name of Imphy Ujine Precision		
<p>This Cobalt-Chromium-Nickel alloy gives a combination of high strength, ductility and good mechanical properties and is age hardenable. Phynox also has excellent fatigue life, corrosion resistance in numerous environments and is non-magnetic.</p> <p>Applications include: use where a high resistance to corrosion and / or low relaxation at temperatures up to 380°C (715°F) are required. Also for springs, seal components, medical devices, components for watches, aerospace, petro-chemical and marine engineering applications.</p>		<h3>APPROXIMATE CHEMICAL COMPOSITION</h3>		
		Co	39 - 41%	
		Cr	19 - 21%	
		Ni	14 - 16%	
		Mo	6 - 8%	
		Fe	BAL	
DENSITY		8.3 g/cm ³	0.300 lb/in ³	
MELTING POINT		1427°C	2600°F	
COEFFICIENT OF EXPANSION		12.5 μm/m • °C (20-100°C)	7.0x10 ⁻⁶ in/in • °F (70-212°F)	
MODULUS OF RIGIDITY		77 kN/mm ²	11168 ksi	
MODULUS OF ELASTICITY		203.4 kN/mm ²	29501 ksi	
CONDITION OF SUPPLY		HEAT TREATMENT (AFTER FORMING)		
Annealed		Phynox cannot be age hardened in the annealed condition.		
Spring Temper		Age harden at 520°C (970°F) for 5 hours and air cool.		
CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	800 - 1000 N/mm ²	116 - 145 ksi	-185 to +450°C	-300 to +840°F
Spring Temper	1400 - 1900 N/mm ²	203 - 276 ksi	-185 to +450°C	-300 to +840°F
Spring Temper + Aged	1900 - 2200 N/mm ²	276 - 319 ksi	-185 to +450°C	-300 to +840°F
STANDARDS				
AMS 5833		ISO 5832		AMS 5834



MP35N^{*}

UNS R30035
AWS 110

^{*} Trade name of SPS Technologies

MP35N is an age hardenable Nickel-Cobalt base alloy that has a unique combination of properties - ultra high strength, toughness, ductility and outstanding corrosion resistance. MP35N resists corrosion in hydrogen sulphide, salt water and other chloride solutions. It also has excellent resistance to crevice and stress corrosion cracking in sea water and other hostile environments.

Applications include:

where a high combination of strength, high modulus values and good corrosion resistance are required. Also medical devices and marine engineering applications.

APPROXIMATE CHEMICAL COMPOSITION

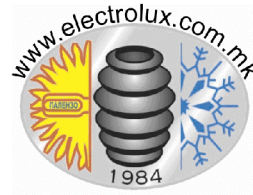
Ni	35%
Co	35%
Cr	20%
Mo	10%

DENSITY	8.43 g/cm ³	0.304 lb/in ³
MELTING POINT	1440°C	2625°F
COEFFICIENT OF EXPANSION	12.8 μm/m • °C (20-100°C)	7.1x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	80.7 kN/mm ²	11705 ksi
MODULUS OF ELASTICITY	234 kN/mm ²	33939 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed	MP35N cannot be age hardened in the annealed condition.
Spring Temper	Age harden at 650°C (1200°F) for 4 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	800 - 1000	116 - 145	-200 to +315	-330 to +600
Spring Temper	1400 - 1900	203 - 276	-200 to +315	-330 to +600
Spring Temper + Aged	1900 - 2200	276 - 319	-200 to +315	-330 to +600

STANDARDS
AMS 5844



Rene 41⁺

W.NR 2.4973
UNS N07041
AWS 120

■ Trade name of General Electric Inc.

Rene 41 is an age hardenable nickel base alloy that has very high strength at elevated temperatures, particularly within the range of 650 - 980°C (1200 - 1800°F). Required mechanical properties can be tailored by selection of various combinations of cold work and/or heat treatments. Rene 41 also has good oxidation resistance.

Applications include:

after burner parts, turbine castings, bolts and other fasteners.

**APPROXIMATE
CHEMICAL COMPOSITION**

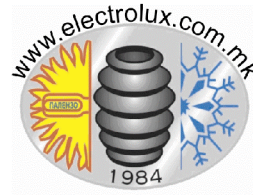
Cr	18 -20%
Co	12%
Mo	9- 10.5%
Ti	3.0 - 3.3%
Al	1.4 -1.6%
Ni	BAL

DENSITY	8.25 g/cm ³	0.298 lb/in ³
MELTING POINT	1345°C	2450°F
COEFFICIENT OF EXPANSION	13.6 μm/m•°C (20-100°C)	7.41x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	83.2 kN/mm ²	12067 ksi
MODULUS OF ELASTICITY	218 kN/mm ²	31619 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Annealed	Age harden at 760°C (1400°F) for 16 hours and air cool.
Spring Temper	1. Solution anneal at 1065°C (1950°F) for 4 hours and air cool 2. + Age at 760°C (1400°F) for 16 hours and air cool.
Spring Temper	Age harden at 760°C (1400°F) for 16 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	800 - 1100	116 - 159	up to +550°C	up to +1020°F
Annealed + Aged	1350 - 1550	196 - 225	up to +550°C	up to +1020°F
Spring Temper	1400 - 1800	203 - 261	up to +550°C	up to +1020°F
Spring Temper + Aged	1600 - 2000	232 - 290	up to +550°C	up to +1020°F

STANDARDS	
AMS 5545	AMS 5800



Alloy 20 CB 3

W.NR 2.4660
UNS N08020
AWS 130

Alloy 20 CB 3 is an austenitic stainless steel with excellent resistance to hot sulphuric acid and many other aggressive environments that would readily attack stainless steel 316. This alloy exhibits superior resistance to stress-corrosion cracking in boiling 20 to 40% sulphuric acid.

Applications include:

chemical and allied industries, and in the processing of synthetic rubber, high-octane gasoline, solvents, pharmaceuticals, and agrichemicals.

APPROXIMATE CHEMICAL COMPOSITION

Ni	32 - 38%
Cr	19 - 21 %
Cu	3 - 4%
Mo	2 - 3%
Fe	BAL
C	0.07% max

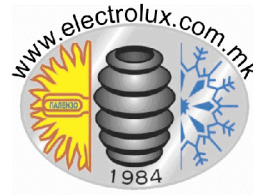
DENSITY	8.08 g/cm ³	0.292 lb/in ³
MELTING POINT	1425°C	2600°F
COEFFICIENT OF EXPANSION	14.69 μm/m•°C (20-100°C)	8.16x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	73.6 kN/mm ²	10675 ksi
MODULUS OF ELASTICITY	193 kN/mm ²	27993 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
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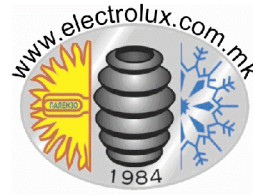
Annealed/Spring Temper

Stress relieve at 250 - 530°C (480 - 990°F) for 1 hour and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	600 - 900 N/mm ²	87 - 131 ksi	-200 to +300°C	-330 to +570°F
Spring Temper	1200 - 1800 N/mm ²	174 - 261 ksi	-200 to +300°C	-330 to +570°F



Beryllium Copper CB 101		UNS C17200 AWS 140		
<p>This age hardenable copper alloy combines a range of properties suited to meet the exacting requirements of many automotive, electronic and aerospace industries.</p> <p><u>Applications include:</u> automotive and aerospace industries</p>		<p>APPROXIMATE CHEMICAL COMPOSITION</p> <p>Cu BAL</p> <p>Be 1.7 - 1.9%</p> <p>Ni+Co 0.05 - 0.40%</p>		
DENSITY		8.25 g/cm ³	0.298 lb/in ³	
MELTING POINT		980°C	1800°F	
COEFFICIENT OF EXPANSION		17.8 μm/m•°C (20-100°C)	9.9x10 ⁻⁶ in/in•°F (70-212°F)	
MODULUS OF RIGIDITY		—	—	
MODULUS OF ELASTICITY		123 kN/mm ²	17840 ksi	
CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)			
Annealed	Age Hardened at 315 - 320°C (600- 610°F) for 3 hours and air cool.			
Hard Drawn	Age Hardened at 315 - 320°C (600- 610°F) for 2 hours and air cool.			
CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	400 - 600 N/mm ²	58 - 87 ksi	up to 200°C	up to 390°F
Annealed + Aged	800 - 1200 N/mm ²	116 - 174 ksi	up to 200°C	up to 390°F
Spring Temper	800 - 1200 N/mm ²	116 - 174 ksi	up to 200°C	up to 390°F
Spring Temper + Aged	1200 - 1600 N/mm ²	174 - 232 ksi	up to 200°C	up to 390°F
STANDARDS				
BS 2873				



Waspaloy⁺

W.NR 2.4654
UNS N07001
AWS 170

+ Trade name of United Technologies Corporation

This age hardenable nickel base super alloy has very good strength in temperatures up to about 980°C (1800°F). Its strength is generally comparable to that of Rene 41 and is generally superior to that of Alloy 718 at temperatures exceeding 650 - 705°C (1200 - 1300°F).

Applications include:

gas turbine engine parts, aerospace components, springs and fasteners.

APPROXIMATE CHEMICAL COMPOSITION

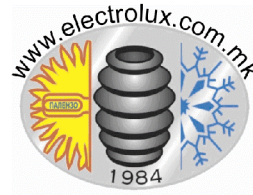
Ni	BAL
Co	13.5%
Fe	2% max
Cr	19%
Mo	4.3%
Al	1.5%
Ti	3%

DENSITY	8.16 g/cm ³	0.295 lb/in ³
MELTING POINT	1330°C	2425°F
COEFFICIENT OF EXPANSION	12.2 μm/m•°C (21-93°C)	6.8x10 ⁻⁶ in/in•°F (70-200°F)
MODULUS OF RIGIDITY	—	—
MODULUS OF ELASTICITY	211 kN/mm ²	30600 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
Solution Annealed	Stabilize at 843°C (1550°F) for 4 hours and air cool. and Age harden at 760°C (1400°F) for 16 hours and air cool.
Spring Temper	Anneal at 1050°C (1920°F) for 4 hours and air cool. and Stabilize at 843°C (1550°F) for 24 hours and air cool. and Age harden at 760°C (1400°F) for 16 hours and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi		
Solution Annealed	800 - 1100	116 - 159	up to +550°C Depending on spring design and operating conditions	up to +1020°F Depending on spring design and operating conditions
Solution Annealed + Aged	1300 - 1500	189 - 218		
Spring Temper	1300 - 1600	189 - 232		
Spring Temper + Annealed and Aged	1300 - 1500	189 - 218		

STANDARDS		
AMS 5544	AMS 5708	AMS 5828



Titanium Grade 5

W.NR 3.7164
W.NR 3.7165
AWS 151

Titanium Grade 5 has good tensile properties at ambient temperature and a useful creep resistance up to 300°C (570°F). Resistance to fatigue and crack propagation is excellent. Like most titanium alloys, Grade 5 has outstanding resistance to corrosion in most natural and many industrial process environments. The ability to age harden this alloy makes it a good choice for such applications as springs and fasteners.

Applications include:

aerospace, surgical implants, jewellery, chemical, springs, bolts and various other fasteners.

APPROXIMATE CHEMICAL COMPOSITION

Ti	BAL
Al	5.5 - 6.75%
V	3.5 - 4.5%
H	0.015% max

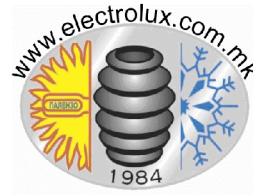
DENSITY	4.42 g/cm ³	0.16 lb/in ³
MELTING POINT	1650°C	3000°F
COEFFICIENT OF EXPANSION	9.0 μm/m•°C (20-100°C)	5.0x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	—	—
MODULUS OF ELASTICITY	105 - 120 kN/mm ²	15230 - 17405 ksi

CONDITION OF SUPPLY HEAT TREATMENT (AFTER FORMING)

Annealed/Spring Temper	Stress relieve at 250 - 650°C (482 - 1200°F) for 30 minutes to 4 hours and air cool.
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CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	950 - 1100	138 - 159	-200 to +400	-330 to +750
Spring Temper	1100 - 1400	159 - 203	-200 to +400	-330 to +750

STANDARDS
ASTM B348



Stainless Steel 302

W.NR 1.4310
UNS S30200
AWS 160

Stainless Steel 302 has good mechanical properties and corrosion resistance.

Applications include:
springs, wire gauze and wire cloth.

APPROXIMATE CHEMICAL COMPOSITION

Cr 17 - 19%
Ni 8 - 10%
Fe BAL

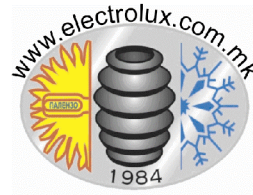
DENSITY	8.0 g/cm ³	0.289 lb/in ³
MELTING POINT	1420°C	2590°F
COEFFICIENT OF EXPANSION	17.6 μm/m•°C (20-100°C)	9.8x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	70.3 kN/mm ²	10196 ksi
MODULUS OF ELASTICITY	187.5 kN/mm ²	27195 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
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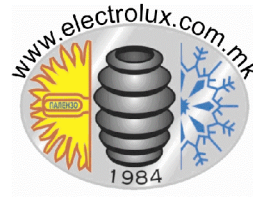
Annealed/Spring Temper	Stress relieve at 250°C (480°F) for 1 hour and air cool.
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CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	600 - 800 N/mm ²	87 - 116 ksi	-200 to +300°C	-330 to +570°F
Spring Temper	1300 - 2200 N/mm ²	189 - 319 ksi	-200 to +300°C	-330 to +570°F

STANDARDS			
BS 970	BS 1554	BS 2056	ASTM A313



Stainless Steel 304		W.NR 1.4301 W.NR 1.4303 W.NR 1.4306 UNS S30400 AWS 161	
<p>Stainless Steel 304, like 302, has good mechanical properties and corrosion resistance.</p> <p><u>Applications include:</u> springs, wire gauze and wire cloth.</p>		APPROXIMATE CHEMICAL COMPOSITION	
		Cr	17 - 19%
		Ni	8 - 11%
		Fe	BAL
DENSITY		8.0 g/cm ³	0.289 lb/in ³
MELTING POINT		1454°C	2650°F
COEFFICIENT OF EXPANSION		18.2 μm/m•°C (20-100°C)	10.1x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY		70.3 kN/mm ²	10196 ksi
MODULUS OF ELASTICITY		187.5 kN/mm ²	27195 ksi
CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)		
Annealed/Spring Temper		Stress relieve at 250°C (480°F) for 1 hour and air cool.	
CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE
Annealed	600 - 800 N/mm ²	87 - 116 ksi	-200 to +300°C -330 to +570°F
Spring Temper	1300 - 2200 N/mm ²	189 - 319 ksi	-200 to +300°C -330 to +570°F
STANDARDS			
BS 970	BS 1554	BS 2056	ASTM A313



Stainless Steel 316

W.NR 1.4401
W.NR 1.4404
UNS S31600
AWS 162

Stainless Steel 316 has slightly better corrosion resistance than 302 and 304. It also has better non-magnetic properties.

Applications include:

more suited to Marine, Food and Medical application than 302 and 304.

APPROXIMATE CHEMICAL COMPOSITION

Cr	16.5 - 18.5%
Ni	10.5 - 13.5%
Fe	BAL
Mo	2.0 - 2.5%

DENSITY	8.0 g/cm ³	0.289 lb/in ³
MELTING POINT	1398°C	2555°F
COEFFICIENT OF EXPANSION	17.5 μm/m•°C (20-100°C)	9.7x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	70.3 kN/mm ²	10196 ksi
MODULUS OF ELASTICITY	187.5 kN/mm ²	27195 ksi

CONDITION OF SUPPLY HEAT TREATMENT (AFTER FORMING)

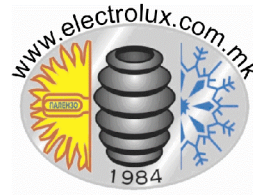
Annealed/Spring Temper

Stress relieve at 250°C (480°F) for 1 hour and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
Annealed	600 - 800 N/mm ²	87 - 116 ksi	-200 to +300°C	-330 to +570°F
Spring Temper	1300 - 2200 N/mm ²	189 - 319 ksi	-200 to +300°C	-330 to +570°F

STANDARDS

BS 970	BS 1554	BS 2056	ASTM A313
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Stainless Steel 316LVM

W.NR 1.4441
UNS S31673
AWS 163

Regarded as 'Medical Grade', this stainless steel 316 is vacuum melted to achieve the extremely high levels of purity and 'cleanliness' required for surgical implants. It has excellent resistance in physiological environments, to general and intergranular corrosion, to pitting and crevice corrosion.

Applications include:
medical implants and high precision electronics.

APPROXIMATE CHEMICAL COMPOSITION

Cr	17 - 19%
Ni	13 - 15%
Mn	2% max
Mo	2.25 - 3.5%
Fe	BAL

DENSITY	8.0 g/cm ³	0.289 lb/in ³
MELTING POINT	1500°C	2730°F
COEFFICIENT OF EXPANSION	16.5 μm/m • °C (20-100°C)	9.2x10 ⁻⁶ in/in • °F (70-212°F)
MODULUS OF RIGIDITY	70.3 kN/mm ²	10196 ksi
MODULUS OF ELASTICITY	187.5 kN/mm ²	27195 ksi

CONDITION OF SUPPLY	HEAT TREATMENT (AFTER FORMING)
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Annealed/Spring Temper

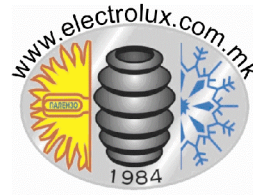
Stress relieve at 250°C (480°F) for 1 hour and air cool.

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	N/mm ²	ksi	°C	°F
Annealed	600 - 800	87 - 116	-200 to +300	-330 to +570
Spring Temper	1300 - 2200	189 - 319	-200 to +300	-330 to +570

STANDARDS

BS 7252 Pt1 COMPOSITION D

ASTM F138



Stainless Steel DTD 189A

AWS 164

This grade of stainless steel is widely used in the aerospace industry.

Applications include:
locking wire and other types of fasteners.

APPROXIMATE CHEMICAL COMPOSITION

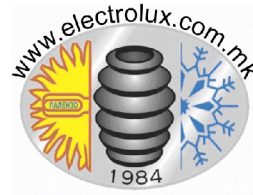
Cr	17 - 20%
Ni	7 - 10%
Ni + Cr	25% min
Fe	BAL

DENSITY	8.0 g/cm ³	0.289 lb/in ³
MELTING POINT	1398°C	2550°F
COEFFICIENT OF EXPANSION	17.5 μm/m•°C (20-100°C)	9.7x10 ⁻⁶ in/in•°F (70-212°F)
MODULUS OF RIGIDITY	70.3 kN/mm ²	10196 ksi
MODULUS OF ELASTICITY	187.5 kN/mm ²	27195 ksi

CONDITION	APPROX TENSILE STRENGTH		APPROX SERVICE TEMPERATURE	
	Annealed	600 - 800 N/mm ²	87 - 116 ksi	-200 to +300°C

STANDARDS

DTD 189A

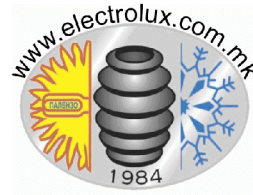


Testing

- Positive Material Identification
- Tensile Strength Tests
- Wrap Tests
- Proof Stress Tests
- Bend Tests
- Elongation
- Torsion Tests
- Post-Heat Treatment Tests
- Hardness Tests

Tolerances

ALLOY WIRE STANDARD TOLERANCES					
inches			mm		
WIREØ	up to but excluding...	TOLERANCE	WIREØ	up to but excluding...	TOLERANCE
0.001"	0.002"	+/- .0002"	0.0254mm	0.0508mm	+/- 0.0051mm
0.002"	0.0148"	+/- .0003"	0.0508mm	0.376mm	+/- 0.0076mm
0.0148"	0.032"	+/- .0004"	0.376mm	0.813mm	+/- 0.0100mm
0.032"	0.048"	+/- .0005"	0.813mm	1.22mm	+/- 0.0127mm
0.048"	0.080"	+/- .0006"	1.22mm	2.03mm	+/- 0.0152mm
0.080"	0.128"	+/- .0008"	2.03mm	3.25mm	+/- 0.0203mm
0.128"	0.176"	+/- .0010"	3.25mm	4.47mm	+/- 0.0254mm
0.176"	0.232"	+/- .0015"	4.47mm	5.89mm	+/- 0.0381mm
0.232"	0.315"	+/- .0025"	5.89mm	8.00mm	+/- 0.0635mm
0.315"	0.395"	+/- .0030"	8.00mm	10.0mm	+/- 0.0760mm
0.395"	0.470"	+/- .0040"	10.0mm	12.0mm	+/- 0.1000mm
0.470"	0.787"	+/- .0050"	12.0mm	20.0mm	+/- 0.1270mm



Packaging

Coil Diameter		Wire Diameter		Weight Range		
1000mm	40"	6mm - 20mm	0.236" - 0.787"	up to 100 kgs	up to 200 pounds	COIL
600mm	24"	1.6mm - 6mm	0.063" - 0.236"	up to 100 kgs	up to 200 pounds	
300mm	12"	0.6mm - 1.6mm	0.024" - 0.063"	up to 50 kgs	up to 100 pounds	
200mm	8"	0.3mm - 0.6mm	0.012" - 0.024"	up to 20 kgs	up to 50 pounds	
						SPOOLS
Din 250		0.25mm - 2.0mm	0.010" - 0.080"	up to 20 kgs	up to 50 pounds	
Din 200		0.25mm - 1.00mm	0.010" - 0.040"	0.up to 10 kgs	up to 25 pounds	
Din 160		0.25mm - 1.00mm	0.010" - 0.040"	up to 7 kgs	up to 15 pounds	
Din 125		0.25mm - 1.00mm	0.010" - 0.040"	up to 3 kgs	up to 7 pounds	
Din 100		0.15mm - 0.30mm	0.006" - 0.012"	up to 1.5 kgs	up to 3 pounds	
Din 80		0.05mm - 0.20mm	0.002" - 0.008"	up to 0.80 kgs	up to 1.5 pounds	
Din 50		0.025mm - 0.05mm	0.001" - 0.002"	up to 0.10 kgs	up to 0.25 pounds	

Quality

Electrolux has held ISO 9000 certification since 1991. This quality approval is essential to our company as it offers the assurance that our products are made to the highest standards. As a rule we supply Certificates with all shipments and, as well as normal chemical analyses, we can offer full mechanical test results. We are able to provide the mechanical tests listed using our in-house testing equipment. In addition, we have examination facilities that allow visual inspection up to 400x, linked to computer software that can produce digital or photographic images. We also have equipment that enables preparation and examination of cross sections of wire. This is useful when looking for problems such as inclusions or seams in wire. All incoming material is visually inspected before processing begins and all our production is checked during processing and at the completion stage for size, properties, chemical analysis and appearance. Most of our work is produced to individual customer specifications that involve producing and proving trials prior to production. All material used by Alloy Wire International is fully certified and traceable back to the primary source. We are able to offer our test facilities on a sub-contract basis and, although not NAMAS certified, our equipment is regularly calibrated and certified by our fully competent staff.