

PRODUCT HANDBOOK OF
**HIGH-PERFORMANCE
NICKEL ALLOYS**

THE ALLOY SPECIALISTS



KX INOX



TRADEMARKS OF THE SPECIAL METALS CORPORATION GROUP OF COMPANIES

- BRIGHTRAY
- DURANICKEL
- FERRY
- INCOFLUX
- INCOLOY
- INCONEL
- INCOTEST
- INCOTHERM
- INCO-WELD
- KOTHERM
- MONEL
- NILO
- NIMONIC
- NI-ROD
- RESISTOHM
- UDIMET
- 27-7MO
- 625LCF
- 718SPF
- 725NDUR
- 740H
- 800HT
- 945
- 945X

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NICKEL

NICKEL 200

Commercially pure [99.6%] wrought nickel with good mechanical properties and resistance to a range of corrosive media. Good thermal, electrical and magnetostrictive properties. Used for a variety of processing equipment, particularly to maintain product purity in handling foods, synthetic fibers and alkalies.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

MAJOR SPECIFICATIONS

UNS N02200	ASME Code Case 2249
BS 3072 - 3076 (NA11)	DIN 17740, 17750 - 17754
ASTM B 160 - B 163, B 366, B 564, B 725, B 730, B 751, B 775, B 829	Werkstoff Nr. 2.4060, 2.4066 ISO 6207, 6208, 9723 - 9725
ASME SB-160 - SB-163, SB-366, SB-564, SB-725, SB-730, SB-751, SB-775, SB-829	

LIMITING CHEMICAL COMPOSITION, %

Ni ^a99.0 min.	Mn.....0.35 max.	S.....0.01 max.
Cu.....0.25 max.	C.....0.15 max.	
Fe.....0.40 max.	Si.....0.35 max.	

^aPlus Co.

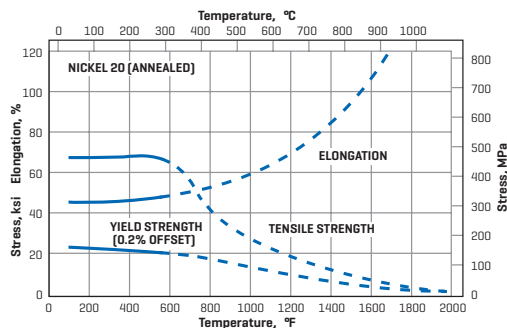
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.321
g/cm ³	8.89
Melting Range, °F.....	2615 - 2635
°C.....	1435 - 1446
Specific Heat, Btu/lb•°F.....	0.109
J/kg•°C.....	456
Curie Temperature, °F.....	680
°C.....	360
Permeability.....	Ferromagnetic
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in•°F.....	7.4
21 - 93°C, μm/m•°C.....	13.3
Thermal Conductivity, Btu • in/ft ² •h•°F.....	487
W/m•°C.....	70.2
Electrical Resistivity, ohm • circ mil/ft.....	58
μΩ • m.....	0.096

TYPICAL MECHANICAL PROPERTIES

(Annealed)

Tensile Strength, ksi.....	67
MPa.....	462
Yield Strength [0.2% Offset], ksi.....	21.5
MPa.....	148
Elongation, %.....	47



— Typical usage range

NICKEL 201

Commercially pure [99.6%] wrought nickel essentially the same as Nickel 200 but with a lower carbon content to prevent embrittlement by intergranular carbon at temperatures over 600°F [315°C]. Lower carbon content also reduces hardness, making Nickel 201 particularly suitable for cold-formed items.

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

UNS N02201	ASME Code Case 2249
BS 3072 - 3074 (NA12)	SAE AMS 5553
ASTM B 160 - B 163, B 366, B 725, B 730, B 751, B 775, B 829	DIN 17740, 17750 - 17754 Werkstoff Nr. 2.4061, 2.4068 VdTUV 345
ASME SB-160 - SB-163, SB-366, SB-725, SB-730, SB-751, SB-775, SB-829	ISO 6207, 6208, 9723 - 9725

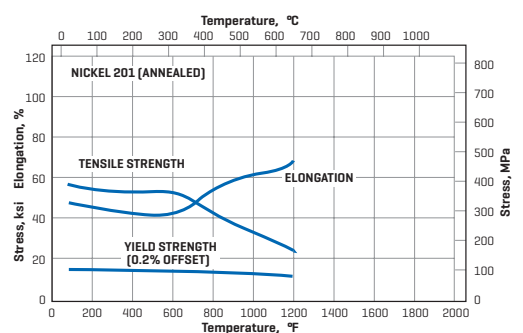
Ni ^a99.0 min.	Mn.....0.35 max.	S.....0.01 max.
Cu.....0.25 max.	C.....0.02 max.	
Fe.....0.40 max.	Si.....0.35 max.	

^aPlus Co.

Density, lb/in ³	0.321
g/cm ³	8.89
Melting Range, °F.....	2615 - 2635
°C.....	1435 - 1446
Specific Heat, Btu/lb•°F.....	0.109
J/kg•°C.....	456
Curie Temperature, °F.....	680
°C.....	360
Permeability.....	Ferromagnetic
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in•°F.....	7.3
21 - 93°C, μm/m•°C.....	13.1
Thermal Conductivity, Btu • in/ft ² •h•°F.....	550
W/m•°C.....	79.3
Electrical Resistivity, ohm • circ mil/ft.....	51
μΩ • m.....	0.085

(Annealed)

Tensile Strength, ksi.....	58.5
MPa.....	403
Yield Strength [0.2% Offset], ksi.....	15
MPa.....	103
Elongation, %.....	50



NICKEL 270

A high-purity grade of nickel made by powder metallurgy. It has a low base hardness and high ductility. Its extreme purity is useful for components of hydrogen thyatron. It is also used for electrical resistance thermometers.

DURANICKEL ALLOY 301

An age-hardened alloy that combines the excellent corrosion resistance characteristics of Nickel 200 with the added advantages of greater strength and hardness. The alloy is used for springs requiring high electrical conductivity, parts of equipment requiring good thermal conductivity and magnetostrictive units, which are operated under stress conditions in which the fatigue strength of Nickel 200 is inadequate.

STANDARD PRODUCT FORMS

Strip, round bar and wire.

Round bar and wire.

MAJOR SPECIFICATIONS

UNS N02270 Werkstoff Nr. 2.4050
ASTM F 3

UNS N03301

LIMITING CHEMICAL COMPOSITION, %

Ni^a.....99.9 min. Mn..... 0.003 max. Ti 0.005 max.
Cu.....0.01 max. C.....0.02 max. Mg..... 0.005 max.
Fe.....0.05 max. S..... 0.003 max. Si..... 0.005 max.
^aPlus Co.

Ni^a.....93.0 min. Cu.....0.25 max. Si.....1.00 max.
Mn.....0.50 max. Fe.....0.60 max. S.....0.01 max.
Ti 0.25 - 1.00 C.....0.30 max. Al.....4.00 - 4.75
^aPlus Co.

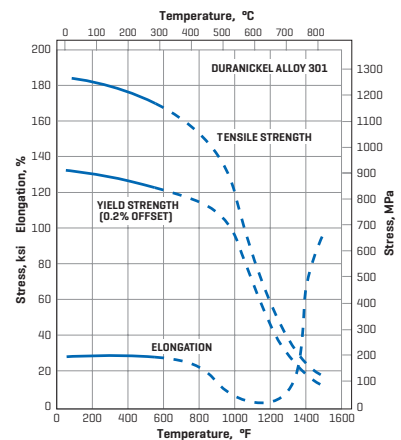
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³.....0.322
g/cm³..... 8.91
Melting Point, °F.....2650
°C.....1454
Specific Heat, Btu/lb•°F.....0.110
J/kg•°C..... 460
Permeability..... Ferromagnetic
Coefficient of Expansion, 70 - 200°F, 10⁻⁶ in/in•°F..... 7.4
20 - 95°C, μm/m•°C..... 13.3
Thermal Conductivity, Btu•in/ft²•h•°F..... 595
W/m•°C..... 86
Electrical Resistivity, ohm•circ mil/ft 45
μΩ•m0.075

Density, lb/in³ [g/cm³]..... 0.296 [8.19]
Melting Range, °F [°C]..... 2550 - 2620 [1400 - 1440]
Specific Heat, Btu/lb•°F [J/kg•°C]..... 0.104 [435]
Curie Temperature^A, °F [°C]..... 200 [95]
Permeability at 200 Oersted^A [15.9 kA/m]..... 10.58
Coefficient of Expansion^A, 10⁻⁶ in/in•°F [μm/m•°C]
70-200°F [21-93°C] 7.2 [13.0]
70-500°F [21-260°C]..... 7.7 [13.9]
70-800°F [21-427°C]..... 8.0 [14.4]
70-1000°F [21-538°C]..... 8.2 [14.8]
70-1200°F [21-650°C]..... 8.5 [15.3]
70-1400°F [21-760°C]..... 8.8 [15.9]
Thermal Conductivity^A, Btu•in/ft²•h•°F [W/m•°C]... 165 [23.8]
Electrical Resistivity^A, ohm•circ mil/ft [μΩ•m]... 255 [0.424]
Young's Modulus^A, 10⁶ psi [GPa]..... 30.0 [207]
Poisson's Ratio^A..... 0.31
Hardness^A, HRC..... 30 - 42
^ARoom temperature, as aged.

TYPICAL MECHANICAL PROPERTIES

[Annealed]
Tensile Strength, ksi..... 50
MPa..... 345
Yield Strength [0.2% Offset], ksi..... 16
MPa..... 110
Elongation, % 50



— Typical usage range

MONEL ALLOY 400

A nickel-copper alloy with high strength and excellent corrosion resistance in a range of media, including sea water, hydrofluoric acid, sulfuric acid and alkalis. Used for marine engineering, chemical and hydrocarbon processing equipment, valves, pumps, shafts, fittings, fasteners and heat exchangers.

MONEL ALLOY R-405

The free-machining version of MONEL alloy 400. A controlled amount of sulfur is added to the alloy to provide sulfide inclusions that act as chip breakers during machining. Other characteristics are essentially the same as those of MONEL alloy 400. Used for meter and valve parts, fasteners and screw-machine products.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

Round bar, hexagon and wire.

MAJOR SPECIFICATIONS

UNS N04400	AECMA Pr EN 2305
BS 3072 - 3076 [NA13]	SAE AMS 4544, 4574,
ASTM B 127, B 163 - B 165,	4675, 4730, 4731, 7233
B 366, B 564, B 725, B 730,	DIN 17743, 17750 - 17754
B 751, B 775, B 829	Werkstoff Nr. 2.4360,
ASME SB-127, SB-163 - SB-165,	2.4361
SB-366, SB-564, SB-725,	VdTUV 263
SB-730, SB-751, SB-775,	QQ-N 281
SB-829	NACE MR-0175/ISO 15156

UNS N04405	SAE AMS 4674, 7234
NACE MR-01-75	QQ-N 281
ASTM B 164	MIL-N-894
ASME SB-164	

LIMITING CHEMICAL COMPOSITION, %

Ni ^a63.0 min.	Mn..... 2.0 max.	S..... 0.5 max.
Cu..... 28.0 - 34.0	C..... 0.3 max.	
Fe..... 2.5 max.	Si..... 0.024 max.	

^aPlus Co.

Ni ^a63.0 min.	S...0.025 - 0.060	Si..... 0.5 max.
Cu..... 28.0 - 34.0	Mn..... 2.0 max.	
Fe..... 2.5 max.	C..... 0.3 max.	

^aPlus Co.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.318
g/cm ³	8.80
Melting Point, °F.....	2370 - 2460
°C.....	1300 - 1350
Specific Heat, Btu/lb • °F.....	0.102
J/kg • °C.....	427
Curie Temperature, °F.....	70 - 120
°C.....	20 - 50
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in • °F.....	7.7
21 - 93°C, µm/m • °C.....	13.9
Thermal Conductivity, Btu • in/ft ² • h • °F.....	151
W/m • °C.....	21.8
Electrical Resistivity, ohm • circ mil/ft.....	329
µΩ • m.....	0.547

Density, lb/in ³	0.318
g/cm ³	8.80
Melting Point, °F.....	2370 - 2460
°C.....	1300 - 1350
Specific Heat, Btu/lb • °F.....	0.102
J/kg • °C.....	427
Curie Temperature, °F.....	70 - 120
°C.....	20 - 50
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in • °F.....	7.6
20 - 95°C, µm/m • °C.....	13.7
Thermal Conductivity, Btu • in/ft ² • h • °F.....	151
W/m • °C.....	21.8
Electrical Resistivity, ohm • circ mil/ft.....	307
µΩ • m.....	0.510

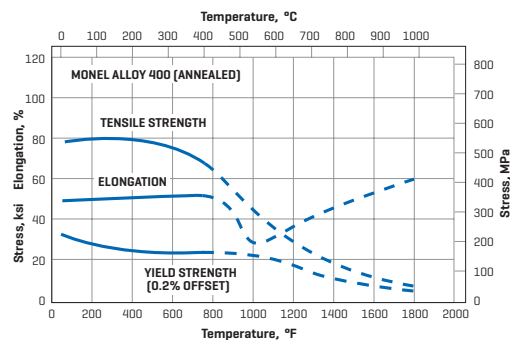
TYPICAL MECHANICAL PROPERTIES

[Annealed]

Tensile Strength, ksi.....	80
MPa.....	550
Yield Strength [0.2% Offset], ksi.....	35
MPa.....	240
Elongation, %.....	40

[Annealed]

Tensile Strength, ksi.....	80
MPa.....	550
Yield Strength [0.2% Offset], ksi.....	35
MPa.....	240
Elongation, %.....	40



— Typical usage range

MONEL ALLOY K-500

A precipitation-hardenable nickel-copper alloy that combines the corrosion resistance of MONEL alloy 400 with greater strength and hardness. It also has low permeability and is nonmagnetic to temperatures as low as -150°F [-101°C]. Used for pump shafts, oil-well tools and instruments, doctor blades and scrapers, springs, valve trim, fasteners and marine propeller shafts.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

MAJOR SPECIFICATIONS

UNS N05500	Werkstoff Nr. 2.4375
BS 3072 - 3076 (NA18)	QQ-N 286
ASTM B 865	NACE MR-0175/ISO 15156
SAE AMS 4676	ISO 6208, 9723 - 9725
DIN 17743, 17752 -17754	ASME Code Case 1192

LIMITING CHEMICAL COMPOSITION, %

Ni ^a63.0 min.	Ti 0.35 - 0.85	Mn..... 1.5 max.
Cu..... 27.0 - 33.0	Fe..... 2.0 max.	S.....0.01 max.
Al..... 2.30 - 3.15	C.....0.25 max.	Si..... 0.5 max.

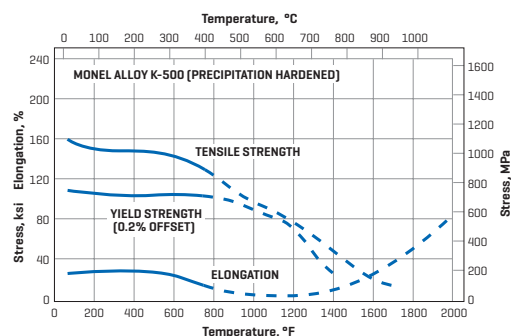
^aPlus Co.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.305
g/cm ³	8.44
Melting Point, °F.....	2400 - 2460
°C.....	1315 - 1350
Specific Heat, Btu/lb • °F.....	0.100
J/kg • °C.....	419
Curie Temperature, °F.....	-150
°C.....	-100
Permeability at 200 Oersted (15.9 kA/m).....	1.002
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in • °F.....	7.6
21 - 93°C, μm/m • °C.....	13.7
Thermal Conductivity, Btu • in/ft ² • h • °F.....	121
W/m • °C.....	17.5
Electrical Resistivity, ohm • circ mil/ft.....	370
μΩ • m.....	0.615
Young's Modulus at RT, 10 ³ ksi.....	26

TYPICAL MECHANICAL PROPERTIES

[Precipitation Hardened]	
Tensile Strength, ksi.....	160
MPa.....	1100
Yield Strength (0.2% Offset), ksi.....	115
MPa.....	790
Elongation, %.....	20



— Typical usage range

INCONEL ALLOY 600

A nickel-chromium alloy with good oxidation resistance at high temperatures and resistance to chloride-ion stress-corrosion cracking, corrosion by high-purity water and caustic corrosion. Used for furnace components, chemical and food processing, nuclear engineering and sparking electrodes.

INCONEL ALLOY 601

A nickel-chromium alloy with an addition of aluminum for outstanding resistance to oxidation and other forms of high-temperature corrosion. It also has high mechanical properties at elevated temperatures. Used for industrial furnaces; heat-treating equipment such as baskets, muffles, and retorts; petrochemical and other process equipment; and gas-turbine components.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon, wire and extruded section.

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

MAJOR SPECIFICATIONS

UNS N06600	SAE AMS 5540, 5580,
BS 3072 - 3076 (NA14)	5665, 5687
ASTM B 163, B 166 - B 168,	DIN 17742, 17750 - 17754
B 366, B 516, B 517, B 564,	Werkstoff Nr. 2.4816
B 751, B 775, B 829	VdTUV 305
ASME SB-163, SB-166 - SB-168,	NACE MR-01-75
SB-366, SB-516, SB-517,	QQ-W 390
SB-564, SB-751, SB-775,	EN 10095
SB-829	ISO 6207, 6208, 9723 -9725,
ASME Code Cases 1827, N-20,	4955A
N-253, N-576	

UNS N06601	ASME Code Case 1500
ASTM B 166 - B 168, B 751,	DIN 17742, 17750 - 17754
B 775, B 829	Werkstoff Nr. 2.4851
ASME SB-166 - SB-168,	EN 10095
SB-751, SB-775, SB-829	ISO 6207, 6208, 9723-9725

LIMITING CHEMICAL COMPOSITION, %

Ni ^a 72.0 min.	C..... 0.15 max.	Si..... 0.5 max.
Cr 14.0 - 17.0	Mn..... 1.0 max.	Cu..... 0.5 max.
Fe..... 6.0 - 10.0	S..... 0.015 max.	

^aPlus Co.

Ni..... 58.0 - 63.0	Fe..... Remainder	Si..... 0.50 max.
Cr..... 21.0 - 25.0	C..... 0.10 max.	S..... 0.015 max.
Al..... 1.0 - 1.7	Mn..... 1.0 max.	Cu..... 1.0 max.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

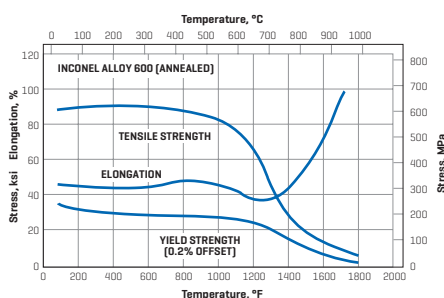
Density, lb/in ³	0.306
g/cm ³	8.47
Melting Range, °F.....	2470 - 2575
°C.....	1354 - 1413
Specific Heat, Btu/lb•°F.....	0.106
J/kg•°C.....	444
Curie Temperature, °F.....	-192
°C.....	-124
Permeability at 200 Oersted [15.9 kA/m].....	1.010
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in•°F.....	7.4
21 - 93°C, μm/m•°C.....	13.3
Thermal Conductivity, Btu • in/ft ² •h•°F.....	103
W/m•°C.....	14.9
Electrical Resistivity, ohm • circ mil/ft.....	620
μΩ • m.....	1.03

Density, lb/in ³	0.293
g/cm ³	8.11
Melting Range, °F.....	2480 - 2571
°C.....	1360 - 1411
Specific Heat, Btu/lb•°F.....	0.107
J/kg•°C.....	448
Curie Temperature, °F.....	< -320
°C.....	< -196
Permeability at 200 Oersted [15.9 kA/m].....	1.003
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in•°F.....	7.60
20 - 100°C, μm/m•°C.....	13.75
Thermal Conductivity, Btu • in/ft ² •h•°F.....	78
W/m•°C.....	11.2
Electrical Resistivity, ohm • circ mil/ft.....	717
μΩ • m.....	1.19

TYPICAL MECHANICAL PROPERTIES

(Annealed)

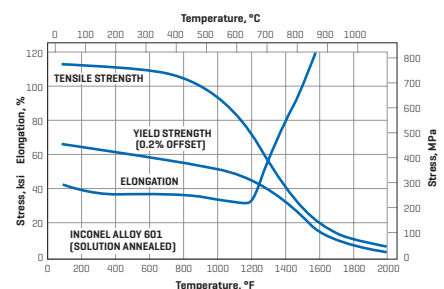
Tensile Strength, ksi.....	95
MPa.....	655
Yield Strength (0.2% Offset), ksi.....	45
MPa.....	310
Elongation, %.....	40



— Typical usage range

(Solution Annealed)

Rupture Strength (1000h)	ksi	MPa
1200°F / 650°C.....	28.0	195
1400°F / 760°C.....	9.1	63
1600°F / 870°C.....	4.3	30
1800°F / 980°C.....	2.1	14
2000°F / 1095°C.....	1.0	7



INCONEL ALLOY 617

A nickel-chromium-cobalt-molybdenum alloy with an exceptional combination of metallurgical stability, strength and oxidation resistance at high temperatures. Resistance to oxidation is enhanced by an aluminum addition. The alloy also resists a wide range of corrosive aqueous environments. Used in gas turbines for combustion cans, ducting and transition liners; petrochemical processing; heat-treating equipment; and in nitric acid production.

INCONEL ALLOY 625

A nickel-chromium-molybdenum alloy with an addition of niobium that acts with the molybdenum to stiffen the alloy's matrix and thereby provide high strength without a strengthening heat treatment. The alloy resists a wide range of severely corrosive environments and is especially resistant to pitting and crevice corrosion. Used in chemical processing, aerospace and marine engineering, pollution-control equipment and nuclear reactors.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, strip, plate, round bar, forging stock, hexagon, wire and extruded section.

Pipe, tube, sheet, strip, plate, round bar, forging stock, hexagon, wire and extruded section.

MAJOR SPECIFICATIONS

UNS N06617	ASME Code Cases 1956, 1982
ASTM B 166, B 168, B 546, B 564	Werkstoff Nr. 2.4663a
ASME SB-166, SB-168, SB-546, SB-564	VdTUV 485
SAE AMS 5887 - 5889	ISO 6207, 6208, 9724 DIN 17744, 17750-17754

UNS N06625	SAE AMS 5581, 5599, 5666, 5837, 5869, MAM 5599
ASTM B 366, B 443, B 444, B 446, B 564, B 704, B 705, B 751, B 775, B 829	BS 3072, 3074, 3076 (NA21) DIN 17744, 17750 - 17754
ASME SB-366, SB-443, SB-444, SB-446, SB-564, SB-704, SB-705, SB-751, SB-775, SB-829	Werkstoff Nr. 2.4856 NACE MR-0175/ISO 15156 VdTUV 499, EN 10095 ISO NW6625, ISO 6207, 6208, 9723 - 9725, 4955A
ASME Code Case 1935	

LIMITING CHEMICAL COMPOSITION, %

Ni.....44.5 min.	C.....0.05 - 0.15	Ti.....0.6 max.
Cr.....20.0 - 24.0	Fe.....3.0 max.	Cu.....0.5 max.
Co.....10.0 - 15.0	Mn.....1.0 max.	B.....0.006 max.
Mo.....8.0 - 10.0	Si.....1.0 max.	
Al.....0.8 - 1.5	S.....0.015 max.	

Ni.....58.0 min.	Fe.....5.0 max.	Al.....0.40 max.
Cr.....20.0 - 23.0	C.....0.10 max.	Ti.....0.40 max.
Mo.....8.0 - 10.0	Mn.....0.50 max.	P.....0.015 max.
Nb ^a ...3.15 - 4.15	Si.....0.50 max.	Co ^b1.0 max.
^a Plus Co.	S.....0.015 max.	^l If determined.

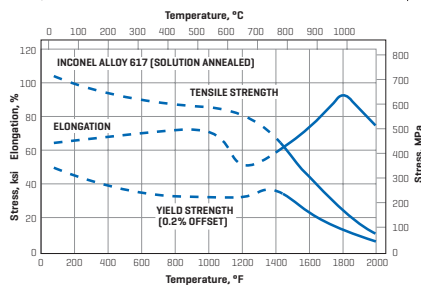
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.302
g/cm ³	8.36
Melting Range, °F.....	2430 - 2510
°C.....	1330 - 1380
Specific Heat, Btu/lb•°F.....	0.100
J/kg•°C.....	419
Coefficient of Expansion, 78 - 200°F, 10 ⁻⁶ in/in•°F.....	6.4
20 - 100°C, μm/m•°C.....	11.6
Thermal Conductivity, Btu • in/ft ² •h•°F.....	94
W/m•°C.....	13.6
Electrical Resistivity, ohm•circ mil/ft.....	736
μΩ•m.....	1.22

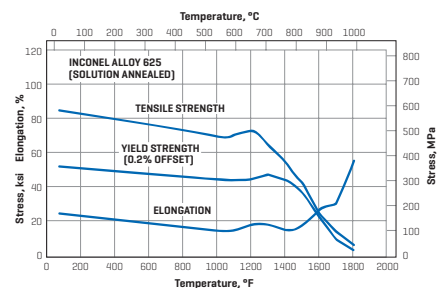
Density, lb/in ³	0.305
g/cm ³	8.44
Melting Range, °F.....	2350 - 2460
°C.....	1290 - 1350
Specific Heat, Btu/lb•°F.....	0.098
J/kg•°C.....	410
Curie Temperature, °F.....	<-320
°C.....	<-196
Permeability at 200 Oersted [15.9 kA/m].....	1.0006
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in•°F.....	7.1
21 - 93°C, μm/m•°C.....	12.8
Thermal Conductivity, Btu • in/ft ² •h•°F.....	68
W/m•°C.....	9.8
Electrical Resistivity, ohm•circ mil/ft.....	776
μΩ•m.....	1.29

TYPICAL MECHANICAL PROPERTIES
[Solution Annealed]

Rupture Strength [1000h]	ksi	MPa
1200°F / 650°C.....	47.0	320
1400°F / 760°C.....	22.0	150
1600°F / 870°C.....	8.4	58
1800°F / 980°C.....	3.6	25
2000°F / 1095°C.....	1.5	10


[Solution Annealed]

Rupture Strength [1000h]	ksi	MPa
1200°F / 650°C.....	52.0	360
1400°F / 760°C.....	23.0	160
1600°F / 870°C.....	7.2	50
1800°F / 980°C.....	2.6	18



— Typical usage range

INCONEL ALLOY 625LCF

A nickel-chromium-molybdenum alloy that was developed as a fatigue-resistant bellows-quality version of INCONEL alloy 625. Alloying, melting and processing of this alloy are specially designed and controlled to provide a sheet product with optimum resistance to low-cycle and thermal fatigue at temperatures up to 1200°F [650°C]. Used in Aircraft exhaust and automotive flexible coupling bellows and expansion joints in various types of process or transport piping.

INCONEL ALLOY 686

An alloy designed for outstanding corrosion-resistance in a wide range of severe environments. The alloy is used in the most severe environments encountered in chemical processing, pollution control, pulp and paper production, and treatment of industrial and municipal wastes. Chemical processing uses include heat exchangers, reaction vessels, evaporators and transfer piping. Air pollution control applications are stack liners, ducts, dampers, scrubbers, stack-gas reheaters, fans and housings.

STANDARD PRODUCT FORMS

Sheet and strip.

Pipe, tube, sheet, strip, plate, round bar, forging stock, hexagon and wire.

MAJOR SPECIFICATIONS

UNS N06625, N06626	ASME Code Case 2276
ASTM B 443	W.Nr. 2.4856
ASME SB-443	BS 3072 [NA21]
SAE AMS 5879	

UNS N06686	ASME SB-163, SB-564,
ASTM B 163, B 462, B 564,	SB-574, SB-575, SB-619,
B 574, B 575, B 619, B 622,	SB-622, SB-626, SB-751,
B 626, B 751, B 775, B 829,	SB-775, SB-829, SB-906
B 906, F 467, F 467M, F 468,	VdTUV 515
F 468M	NACE MR-0175/ISO 15156
DIN 17744, 17750 - 17754	SAE/AMS J2295, J2271, J2655,
Werkstoff Nr. 2.4606	J2280, J2485
ASME Code Case 2198	

LIMITING CHEMICAL COMPOSITION, %

Ni.....58.0 min.	Fe..... 5.0 max.	S..... 0.015 max.
Cr 20.0 - 23.0	C.....0.03 max.	Al0.40 max.
Mo..... 8.0 - 10.0	Si.....0.15 max.	Ti0.40 max.
Nb ^a ...3.15 - 4.15	N.....0.02 max.	P..... 0.015 max.
^a Plus Co.	Mn.....0.50 max.	Co..... 1.0 max.

Cr..... 19.0 - 23.0	Fe..... 1.0 max.	Si.....0.08 max.
Mo.... 15.0 - 17.0	C.....0.01 max.	P.....0.04 max.
W..... 3.0 - 4.4	Mn.....0.75 max.	Ni..... Balance
Ti 0.02 - 0.25	S.....0.02 max.	

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.305
g/cm ³	8.44
Melting Range, °F.....	2350 - 2460
°C.....	1290 - 1350
Specific Heat, Btu/lb•°F.....	0.098
J/kg•°C.....	410
Curie Temperature, °F.....	<-320
°C.....	<-196
Permeability at 200 Oersted [15.9 kA/m].....	1.0006
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in•°F.....	7.1
20 - 100°C, μm/m•°C.....	12.8
Thermal Conductivity, Btu • in/ft ² •h•°F.....	68
W/m•°C.....	9.7
Electrical Resistivity, ohm • circ mil/ft.....	776
μΩ • m.....	1.29

Density, lb/in ³	0.315
g/cm ³	8.73
Melting Range, °F.....	2440 - 2516
°C.....	1338 - 1380
Specific Heat, Btu/lb•°F.....	0.089
J/kg•°C.....	373
Permeability at 200 Oersted [15.9 kA/m].....	1.001
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in•°F.....	6.67
20 - 100°C, μm/m•°C.....	11.97
Electrical Resistivity, ohm • circ mil/ft.....	744.4
μΩ • m.....	1.237

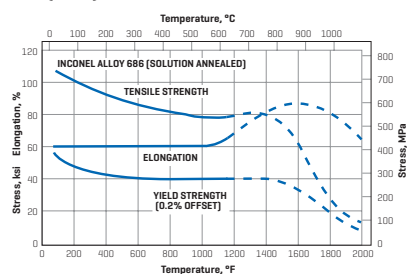
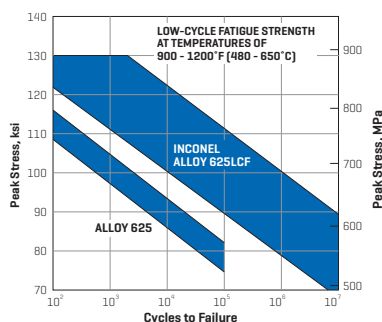
TYPICAL MECHANICAL PROPERTIES

(Annealed)

Tensile Strength, ksi.....	130
MPa.....	894
Yield Strength (0.2% Offset), ksi.....	68
MPa.....	469
Elongation, %.....	50

(Annealed)

Tensile Strength, ksi.....	110
MPa.....	758
Yield Strength (0.2% Offset), ksi.....	55
MPa.....	379
Elongation, %.....	60
Hardness [HRB].....	85 - 95



— Typical usage range

INCONEL ALLOY 690

INCONEL alloy 690 is a high-chromium nickel alloy with excellent resistance to many corrosive aqueous media and high-temperature atmospheres. The alloy's high chromium content gives it excellent resistance to aqueous corrosion by oxidizing acids (especially nitric acid) and salts, and to sulfidation at high-temperatures. In addition to its corrosion resistance, alloy 690 has high strength, good metallurgical stability and favorable fabrication characteristics.

INCONEL ALLOY 693

A nickel-chromium-aluminum alloy offering the best resistance to metal dusting of any available conventional alloy. Alloy 693 also offers exceptional resistance to oxidation and carburization at temperatures up to 2100°F [1150°C] with excursions to even higher temperatures. The alloy's ability to resist metal dusting is especially useful in systems used to reform hydrogen and generate synthesis gas for various industries, including gas and liquid fuel production. Alloy 693 is protected by U.S. Patent Number 4,882,125.

STANDARD PRODUCT FORMS

Pipe, tube, plate, round bar and forging stock.

Plate, sheet, strip, bar, seamless tubes and pipes.

MAJOR SPECIFICATIONS

UNS N06690	ASME SB-163, SB-166 -
ASTM B 163, B 166 - B 168,	SB-168, SB-564, SB-829
B 564, B 829	Werkstoff Nr. 2.4642
ASME Code Cases 2083,	ISO 6207, 6208, 9723
N-20, N-525	ISO NW6690

UNS N06693
ASTM B 166, B 167, B 168
ASME SB 166, SB 167, SB 168

LIMITING CHEMICAL COMPOSITION, %

Ni ^a58.0 min.	Mn.....0.50 max.
Cr.....27.0 - 31.0	S.....0.015 max.
Fe.....7.0 - 11.0	Si.....0.50 max.
C.....0.05 max.	Cu.....0.50 max.

^aPlus Co.

Ni....Remainder ^a	Nb.....0.5-2.5	Si.....0.50 max.
Cr.....27.0 - 31.0	Mn.....1.0 max.	C.....0.15 max.
Fe.....2.5-6.0	Ti.....1.0 max.	S.....0.015 max.
Al.....2.5-4.0	Cu.....0.50 max.	

^aElement determined arithmetically by difference.

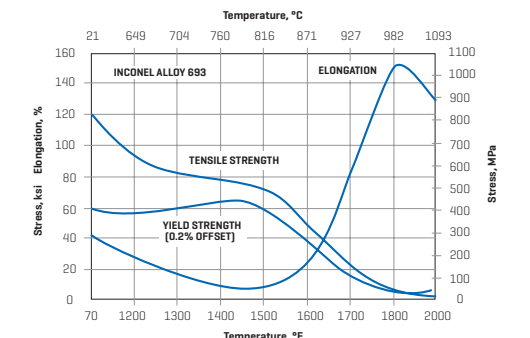
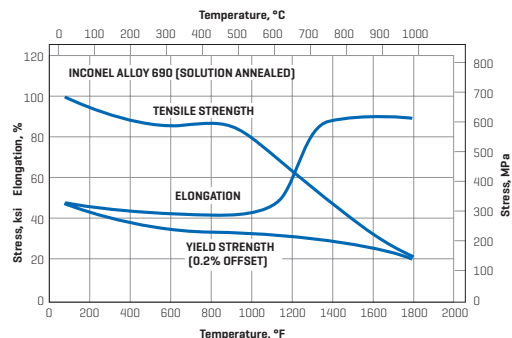
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.296
g/cm ³	8.19
Melting Range, °F.....	2450 - 2510
°C.....	1343 - 1377
Specific Heat, Btu/lb•°F.....	0.107
J/kg•°C.....	450
Permeability at 200 Oersted [15.9 kA/m].....	1.001
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [µm/m•°C]	
70-200°F [21-93°C].....	7.80 [14.0]
70-1000°F [21-538°C].....	8.53 [15.4]
70-1600°F [21-970°C].....	9.38 [16.9]
Thermal Conductivity ^A , Btu•in/ft ² •h•°F.....	84
W/m•°C.....	12.1
Electrical Resistivity ^A , ohm•circ mil/ft.....	.691
µΩ•m.....	1.15
Young's Modulus ^A , 10 ⁶ psi.....	30.6
GPa.....	211
Poisson's Ratio ^A	0.29
Hardness ^A , HRB.....	85

^ARoom temperature, as aged.

Density, lb/in ³	0.280
g/cm ³	7.77
Melting Range, °F.....	2403 - 2493
°C.....	1317 - 1367
Specific Heat, Btu/lb•°F.....	0.109
J/kg•°C.....	455
Permeability at 200 Oersted.....	<1.005
Electrical Resistivity ^A , ohm•circ mil/ft.....	702.7
Thermal Conductivity ^A , Btu•in/ft ² •h•°F.....	64.3
W/m•°C.....	9.1
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [µm/m•°C]	
70-200°F [21-93°C].....	7.22 [13.04]
Young's Modulus ^A , 10 ³ psi.....	28.5
GPa.....	197
Shear Modulus ^A , 10 ³ psi.....	11.0
GPa.....	76
Poisson's Ratio ^A	0.30

^ARoom temperature, as aged.

TYPICAL MECHANICAL PROPERTIES


INCONEL ALLOY 706

INCONEL alloy 706 is a precipitation-hardenable nickel-iron-chromium alloy that provides high mechanical strength in combination with good fabricability. The properties of the alloy are similar to those of INCONEL alloy 718 (N07718) except that alloy 706 is more readily fabricated, particularly by machining. Primary uses of the alloy are aerospace and land-based gas turbine parts and components, requiring resistance to creep, and stress rupture up to 1300°F [704°C], oxidation resistance and good fabricability.

INCONEL ALLOY 718 & 718SPF

Inconel alloy 718 is a precipitation-hardenable nickel-chromium alloy also containing significant amounts of iron, niobium and molybdenum along with lesser amounts of aluminum and titanium. It combines corrosion resistance and high strength with outstanding weldability, including resistance to post-weld cracking. The alloy has excellent creep-rupture strength at temperatures to 1300°F [700°C]. Used in gas turbines, rocket motors, spacecraft, nuclear reactors, pumps and tooling. INCONEL alloy 718SPF is a special version designed for superplastic forming.

STANDARD PRODUCT FORMS

Round bar and forging stock.

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon, wire and extruded section.

MAJOR SPECIFICATIONS

UNS N09706
SAE AMS 5605, 5606, 5701 - 5703

UNS N07718, N07719	ASME Code Cases 1993, 2206,
ASTM B 637, B 670	2222, N-62, N-208, N-253
ASME SB-637, SB-670	NACE MR-0175/ISO 15156
DIN 17744, 17750-17754	AECMA Pr EN 2404,
SAE AMS 5589, 5590, 5596,	2405, 2407, 2408,
5597, 5662 - 5664, 5832,	2952, 2961, 3219, 3666
5914, 5950, 5962	ISO 6208, 9723 - 9725
Werkstoff Nr. 2.4668	

LIMITING CHEMICAL COMPOSITION, %

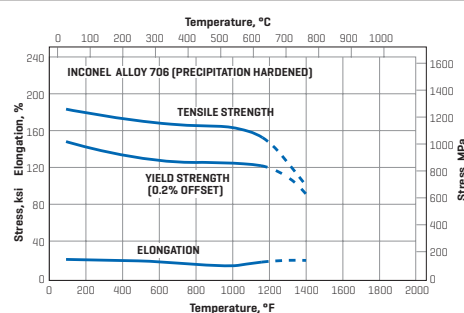
Ni ^a 39.0 - 44.0	Ti..... 1.5 - 2.0	S..... 0.015 max.
Cr..... 14.5 - 17.5	Al..... 0.40 max.	Si..... 0.35 max.
Fe..... Remainder	C..... 0.06 max.	P..... 0.020 max.
Nb ^b 2.5 - 3.3	Cu..... 0.30 max.	B..... 0.006 max.
^a Plus Co. ^b Plus Ta.	Mn..... 0.35 max.	Co..... 1.00 max.

Ni ^a 50.0 - 55.0	Ti..... 0.65 - 1.15	Si..... 0.35 max.
Cr..... 17.0 - 21.0	Al..... 0.20 - 0.80	P..... 0.015 max.
Fe..... Remainder	Co ^c 1.0 max.	S..... 0.015 max.
Nb ^b 4.75 - 5.50	C..... 0.08 max.	B..... 0.006 max.
Mo..... 2.80 - 3.30	Mn..... 0.35 max.	Cu..... 0.30 max.
^a Plus Co. ^b Plus Ta. ^c If determined.		

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³ [g/cm³]..... 0.291 [8.05]
Melting Range, °F [°C]..... 2434 - 2499 [1334 - 1371]
Specific Heat, Btu/lb•°F [J/kg•°C]..... 0.106 [444]
Curie Temperature, °F [°C]..... < -109 [-78]
Permeability at 200 Oersted [15.9 kA/m]..... 1.011
Coefficient of Expansion, 10⁻⁶ in/in•°F [µm/m•°C]
70-200°F [21-93°C]..... 7.40 [13.3]
70-500°F [21-260°C]..... 8.25 [14.9]
70-800°F [21-427°C]..... 8.57 [15.4]
70-1000°F [21-538°C]..... 8.73 [15.7]
70-1200°F [21-650°C]..... 8.97 [16.2]
Thermal Conductivity^A, Btu•in/ft²•h•°F..... 87
W/m•°C..... 12.5
Electrical Resistivity^A, ohm•circ mil/ft..... 592
µΩ•m..... 0.985
Young's Modulus^A, 10⁶ psi [GPa]..... 30.4 [210]
Shear's Modulus^A, 10⁶ psi [GPa]..... 11.0 [76]
Poisson's Ratio^A..... 0.382
Hardness^A, HRC..... 36 - 42
^ARoom temperature, as aged.

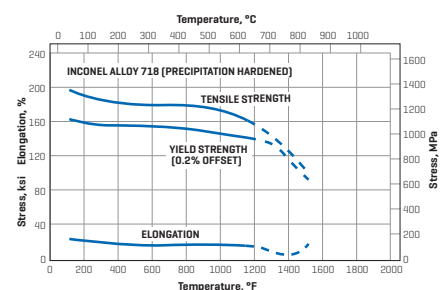
Density, lb/in³..... 0.296
g/cm³..... 8.19
Melting Point, °F..... 2300 - 2437
°C..... 1260 - 1336
Specific Heat, Btu/lb•°F..... 0.104
J/kg•°C..... 435
Curie Temperature, °F..... -170
°C..... -112
Permeability at 200 Oersted [15.9 kA/m]..... 1.0011
Coefficient of Expansion, 70 - 200°F, 10⁻⁶ in/in•°F..... 7.2
21 - 93°C, µm/m•°C..... 13.0
Thermal Conductivity, Btu•in/ft²•h•°F..... 79
W/m•°C..... 11.4
Electrical Resistivity, ohm•circ mil/ft..... 751
µΩ•m..... 1.25

TYPICAL MECHANICAL PROPERTIES


— Typical usage range

(Solution Annealed)

Rupture Strength [1000h]	ksi	MPa
1100°F / 595°C.....	110	760
1200°F / 650°C.....	86	590
1300°F / 705°C.....	53	370
1400°F / 760°C.....	24	170



— Typical usage range

INCONEL ALLOY 725

A nickel-chromium-molybdenum-niobium alloy that is highly resistant to corrosion and is age hardenable for extremely high strength. The strength of this alloy is developed by heat treatment to achieve high ductility and toughness. The alloy is resistant to hydrogen embrittlement and stress-corrosion cracking. Used for hangers, landing nipples, side pocket mandrels and polished bore receptacles in sour gas service. Also used for high-strength fasteners in marine applications.

STANDARD PRODUCT FORMS

Round bar and wire.

MAJOR SPECIFICATIONS

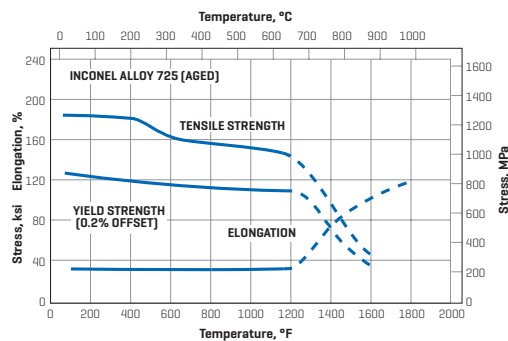
 UNS N07725 SMC HA91
 ASTM B 805
 ASME Code Case 2217
 NACE MR-0175/ISO 15156

LIMITING CHEMICAL COMPOSITION, %

Ni..... 55.0 – 59.0	Ti1.0 – 1.7	Si.....0.20 max.
Cr..... 19.0 – 22.5	Al.....0.35 max.	P..... 0.015 max.
Mo..... 7.0 – 9.5	C.....0.03 max.	S..... 0.010 max.
Nb..... 2.75 – 4.0	Mn.....0.35 max.	Fe..... Balance

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.300
g/cm ³	8.31
Melting Point, °F.....	2320 – 2449
°C.....	1271 – 1343
Permeability at 200 Oersted [15.9 kA/m].....	<1.001
Coefficient of Expansion, 70 – 200°F, 10 ⁻⁶ in/in •°F.....	7.22
20 – 100°C, μm/m •°C.....	13.0
Thermal Conductivity, Btu • in/ft ² • h •°F.....	73.8
W/m •°C.....	10.6
Electrical Resistivity, ohm • circ mil/ft.....	688
μΩ • m.....	1.144

TYPICAL MECHANICAL PROPERTIES


— Typical usage range

INCONEL ALLOY 740H

A nickel-chromium-cobalt superalloy age hardened by the precipitation of a gamma prime second phase. Alloy 740H exhibits excellent high temperature strength in the age-hardened condition up to 1500°F [815°C]. With its high contents of chromium and cobalt, alloy 740H offers excellent resistance to oxidation, carburization and sulfidation at elevated temperatures. Alloy 740H is targeted for use as advanced power production boiler tubes.

Bar, seamless tubes.

Contact Special Metals

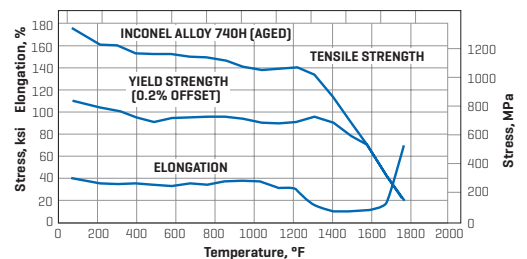
Nominal

C..... 0.03	Co..... 20.0	Mn..... 0.30
Ni..... Balance	Al..... 1.0	Fe..... 0.7
Cr..... 25.0	Ti 1.8	Si..... 0.5
Mo..... 0.5	Nb 2.0	

Density, lb/in ³	0.291
g/cm ³	8.05
Melting Point, °F.....	2350 – 2484
°C.....	1288 – 1362
Specific Heat, Btu/lb •°F.....	0.108
J/kg •°C.....	449
Electrical Resistivity, ohm • circ mil/ft.....	702.7
μΩ • m.....	1.168
Thermal Conductivity, Btu • in/ft ² • h •°F.....	72.9
W/m •°C.....	10.2
Coefficient of Expansion, 10 ⁻⁶ in/in •°F [μm/m •°C]	
70-200°F [21-93°C].....	6.84 [12.38]
Young's Modulus ^A , 10 ³ psi.....	32
GPa.....	221
Shear's Modulus ^A , 10 ³ psi.....	11.5
GPa.....	79
Poisson's Ratio ^A	0.35
Magnetic Permeability.....	<1.005

^ARoom temperature, as aged.

Yield Strength, Room Temperature, Aged, ksi.....	111
Tensile Strength, Room Temperature, Aged, ksi.....	170
Elongation, Aged, %.....	36



INCONEL ALLOY X-750

A nickel-chromium alloy similar to INCONEL alloy 600 but made precipitation hardenable by additions of aluminum and titanium. It has good resistance to corrosion and oxidation along with high tensile and creep-rupture properties at temperatures to 1300°F [700°C]. Its excellent relaxation resistance is useful for high-temperature springs and bolts. Used in gas turbines, rocket engines, nuclear reactors, pressure vessels, tooling and aircraft structures.

INCONEL ALLOY 751

A nickel-chromium alloy similar to INCONEL alloy X-750 but with increased aluminum content for greater precipitation hardening. This alloy was designed for use as exhaust valves in internal-combustion engines. In that application, the alloy offers high strength at operating temperatures, high hot hardness for wear resistance, and corrosion resistance in hot exhaust gases containing lead oxide, sulfur, bromine and chlorine.

STANDARD PRODUCT FORMS

Sheet, strip, plate, round bar, flat bar, forging stock, hexagon, wire, tubing and extruded section.

Round bar.

MAJOR SPECIFICATIONS

UNS N07750	SAE AMS 5542, 5582, 5583,
BS HR 505	5598, 5667 - 5671, 5698,
ASTM B 637	5699, 5747
ASME SB-637	EN 10269
Werkstoff Nr. 2.4669	ISO 6208, 9723 - 9725
NACE MR-0175/ISO 15156	

UNS N07751

LIMITING CHEMICAL COMPOSITION, %

Ni ^a 70.0 min.	Al..... 0.40 - 1.00	Si..... 0.50 max.
Cr..... 14.0 - 17.0	Nb ^b ... 0.70 - 1.20	S..... 0.01 max.
Fe..... 5.0 - 9.0	C..... 0.08 max.	Cu..... 0.50 max.
Ti..... 2.25 - 3.75	Mn..... 1.00 max.	Co ^c 1.00 max.
^a Plus Co.	^b Plus Ta.	^c If determined.

Limiting

Ni ^a 70.0 min.	Ti..... 2.0 - 2.6	Mn..... 1.0 max.
Cr..... 14.0 - 17.0	Al..... 0.9 - 1.5	Si..... 0.5 max.
Fe..... 5.0 - 9.0	Nb ^b 0.7 - 1.2	S..... 0.01 max.
^a Plus Co.	^b Plus Ta.	C..... 0.10 max.
		Cu..... 0.05 max.

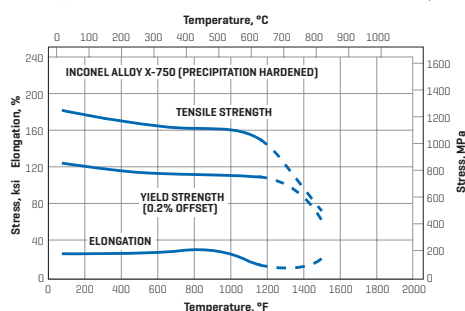
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.299
g/cm ³	8.28
Melting Point, °F.....	2540 - 2600
°C.....	1390 - 1430
Specific Heat, Btu/lb • °F.....	0.103
J/kg • °C.....	431
Curie Temperature, °F.....	-193
°C.....	-125
Permeability at 200 Oersted [15.9 kA/m].....	1.0035
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in • °F.....	7.0
21 - 93°C, μm/m • °C.....	12.6
Thermal Conductivity, Btu • in/ft ² • h • °F.....	83
W/m • °C.....	12.0
Electrical Resistivity, ohm • circ mil/ft.....	731
μΩ • m.....	1.22

Density, lb/in ³	0.297
g/cm ³	8.22
Melting Point, °F.....	2540 - 2600
°C.....	1390 - 1430
Specific Heat, Btu/lb • °F.....	0.103
J/kg • °C.....	431
Curie Temperature, °F.....	-193
°C.....	-125
Permeability at 200 Oersted [15.9 kA/m].....	1.0035
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in • °F.....	7.0
21 - 93°C, μm/m • °C.....	12.6
Thermal Conductivity, Btu • in/ft ² • h • °F.....	83
W/m • °C.....	12.0
Electrical Resistivity, ohm • circ mil/ft.....	731
μΩ • m.....	1.22

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

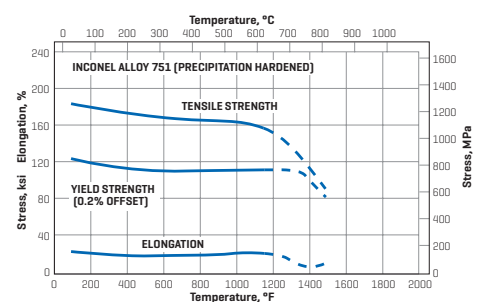
Rupture Strength (1000h)	ksi	MPa
1100°F / 595°C.....	92	630
1200°F / 650°C.....	68	470
1350°F / 730°C.....	37	260
1500°F / 815°C.....	16	110



— Typical usage range

[Precipitation Hardened]

Rupture Strength (1000h)	ksi	MPa
1200°F / 650°C.....	40	280
1350°F / 730°C.....	35	240
1500°F / 815°C.....	14	97



— Typical usage range

INCONEL ALLOY 783

An oxidation-resistant low coefficient of thermal expansion (low CTE) superalloy developed for gas turbine applications. The alloy is strengthened by a precipitation-hardening heat treatment made possible by additions of niobium and aluminum. In addition, the aluminum content provides excellent resistance to oxidation at high temperatures. The alloy's density is 5% less than those of superalloys such as INCONEL alloy 718. The combination of low expansion, high strength and excellent resistance to oxidation makes the alloy especially useful for gas turbine and steam turbine components. The low expansion enables closer control of clearances and tolerances for greater power output and fuel efficiency.

STANDARD PRODUCT FORMS

Sheet, round bar, wire and extruded section.

MAJOR SPECIFICATIONS

UNS R30783
SAE AMS 5940

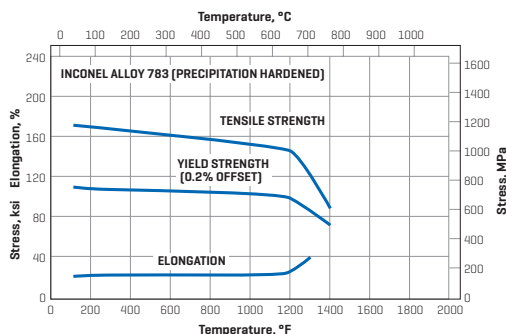
LIMITING CHEMICAL COMPOSITION, %

Ni..... 26.0 – 30.0	Cr 2.5 – 3.5	Mn..... 0.50 max.
Fe..... 24.0 – 27.0	Ti 0.1 – 0.4	P..... 0.015 max.
Co..... Remainder	B..... 0.003 – 0.012	S..... 0.005 max.
Al 5.0 – 6.0	C..... 0.3 max.	Si..... 0.50 max.
Nb 2.5 – 3.5	Cu..... 0.50 max.	

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³ [g/cm ³].....	0.282 [7.81]
Melting Range, °F [°C].....	2437 – 2565 [1336 – 1407]
Specific Heat, Btu/lb•°F [J/kg•°C].....	0.109 [455]
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [μm/m•°C]	
70-200°F [21-93°C].....	5.60 [10.08]
70-500°F [21-260°C].....	5.74 [10.94]
70-800°F [21-427°C].....	6.08 [10.67]
70-1000°F [21-538°C].....	6.57 [11.83]
70-1200°F [21-650°C].....	7.15 [12.87]
Thermal Conductivity ^A , Btu•in/ft ² •h•°F [W/m•°C]....	70.9 [10.2]
Electrical Resistivity ^A , ohm•circ mil/ft [μΩ•m]....	615 [1.021]
Young's Modulus ^A , 10 ⁶ psi [GPa].....	26.8 [185]
Shear's Modulus ^A , 10 ⁶ psi [GPa].....	9.7 [67]
Poisson's Ratio ^A	0.38
Hardness ^A , HRC.....	30 – 38

^ARoom temperature, as aged.

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

INCONEL ALLOY 22

By virtue of its contents of chromium, molybdenum, tungsten and controlled iron, this alloy exhibits excellent resistance to both oxidizing and reducing acid environments, as well as those containing mixed acids. It is particularly useful for resistance to pitting and crevice corrosion in acid-halide environments. Applications include the chemical processing, pollution control, flue gas desulfurization, waste incineration and pulp and paper processing industries.

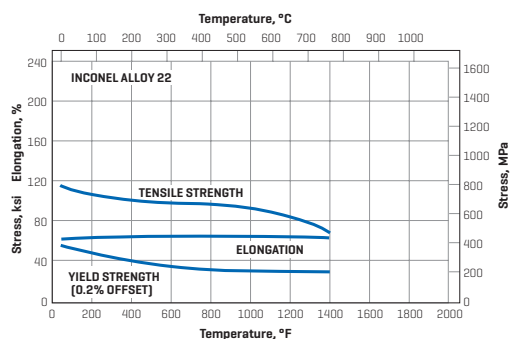
Sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

USN N06022	ASME Code Cases 2226,
ASTM B 366, B 462, B 564, B 574,	N-621
B 575, B 619, B 622, B 626,	Werkstoff Nr. 2.4602
B 751, B 775, B 829, B 906	ISO 6207, 6208, 9723,
ASME SB-366, SB-564, SB-574,	9724
SB-575, SB-619, SB-622,	DIN 17744, 17750-17754
SB-626, SB-751, SB-775,	
SB-829, SB-906	

Ni..... Remainder	W..... 2.5 – 3.5	V..... 0.35 max.
Cr 20.0 – 22.5	Co..... 2.5 max.	S..... 0.02 max.
Mo..... 12.5 – 14.5	C..... 0.015 max.	Si..... 0.08 max.
Fe..... 2.0 – 6.0	Mn..... 0.50 max.	P..... 0.02 max.

Density, lb/in ³ [g/cm ³].....	0.311 [8.61]
Melting Range, °F [°C].....	2464 – 2529 [1351 – 1387]
Specific Heat, Btu/lb•°F [J/kg•°C].....	0.091 [381]
Curie Temperature, °F [°C].....	< -320 [-196]
Permeability at 200 Oersted [15.9 kA/m].....	< 1.001
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [μm/m•°C]	
70-200°F [21-93°C].....	6.90 [12.42]
70-1000°F [21-538°C].....	7.46 [13.43]
70-1800°F [21-982°C].....	7.84 [14.11]
Thermal Conductivity ^A , Btu•in/ft ² •h•°F [W/m•°C].....	91 [13.2]
Electrical Resistivity ^A , ohm•circ mil/ft [μΩ•m]....	730.7 [1.215]
Young's Modulus ^A , 10 ⁶ psi [GPa].....	30.3 [209]
Shear's Modulus ^A , 10 ⁶ psi [GPa].....	11.0 [75.8]
Poisson's Ratio ^A	0.30
Hardness ^A , HRB.....	86

^ARoom temperature, as aged.



INCONEL ALLOY C-276

A nickel-molybdenum-chromium alloy with an addition of tungsten having excellent corrosion resistance in a wide range of severe environments. The high molybdenum content makes the alloy especially resistant to pitting and crevice corrosion. The low carbon content minimizes carbide precipitation during welding to maintain corrosion resistance in as-welded structures. Used in pollution control, chemical processing, pulp and paper production and waste treatment.

INCONEL ALLOY G-3

A nickel-chromium-iron alloy with additions of molybdenum and copper. It has good weldability and resistance to intergranular corrosion in the welded condition. The low carbon content helps prevent sensitization and consequent intergranular corrosion of weld heat-affected zones. Used for flue-gas scrubbers and for handling phosphoric and sulfuric acids.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

Pipe and tube.

MAJOR SPECIFICATIONS

UNS N10276	ASME SB-366, SB-564,
ASTM B 366, B 462, B 564, B 574, B 575, B 619, B 622, B 626, B 751, B 775, B 829	SB-574, SB-575, SB-619, SB-622, SB-626, SB-751, SB-775, SB-829
DIN 17744, 17750 - 17754	ASME Code Case 1924
Werkstoff Nr. 2.4819	NACE MR-0175/ISO 15156
VdTÜV 400	ISO 6207, 6208, 9723 - 9725

UNS N06985	ASME SB-366, SB-581, SB-582,	ASME SB-366, SB-581, SB-582,
ASTM B 366, B 581, B 582, B 619, B 622, B 626, B 751, B 775, B 829	SB-619, SB-622, SB-626, SB-751, SB-775, SB-829	SB-619, SB-622, SB-626, SB-751, SB-775, SB-829
NACE MR-0175/ISO 15156	DIN 17744, 17750 - 17752	DIN 17744, 17750 - 17752
	Werkstoff Nr. 2.4619	Werkstoff Nr. 2.4619
	ISO 6207, 6208, 9724	ISO 6207, 6208, 9724

LIMITING CHEMICAL COMPOSITION, %

Ni.....Remainder	W.....3.0 - 4.5	V.....0.35 max.
Mo.... 15.0 - 17.0	Co..... 2.5 max.	P.....0.04 max.
Cr 14.5 - 16.5	Mn..... 1.0 max.	S.....0.03 max.
Fe..... 4.0 - 7.0	C.....0.01 max.	Si.....0.08 max.

Ni.....Remainder	Nb ^a0.50 max.	Mn..... 1.0 max.
Cr.....21.0 - 23.5	C..... 0.015 max.	P.....0.04 max.
Fe.... 18.0 - 21.0	W..... 1.5 max.	S.....0.03 max.
Mo..... 6.0 - 8.0	Si..... 1.0 max.	Co..... 5.0 max.
Cu..... 1.5 - 2.5	^a Plus Co.	

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

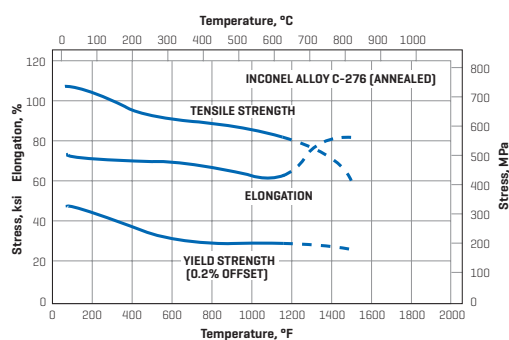
Density, lb/in ³	0.321
g/cm ³	8.89
Melting Point, °F.....	2415 - 2500
°C.....	1325 - 1370
Specific Heat, Btu/lb • °F.....	0.102
J/kg • °C.....	427
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in • °F.....	6.8
24 - 100°C, μm/m • °C.....	12.2
Thermal Conductivity, Btu • in/ft ² • h • °F.....	67.9
W/m • °C.....	9.8
Electrical Resistivity, ohm • circ mil/ft.....	739.2
μΩ • m.....	1.229
Permeability at 200 Oersted [15.9 kA/m].....	1.0002

Density, lb/in ³	0.294
g/cm ³	8.14
Melting Point, °F.....	2300 - 2450
°C.....	1260 - 1340
Specific Heat, Btu/lb • °F.....	0.108
J/kg • °C.....	452
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in • °F.....	8.1
24 - 100°C, μm/m • °C.....	14.6
Thermal Conductivity, Btu • in/ft ² • h • °F.....	69
W/m • °C.....	10.0

TYPICAL MECHANICAL PROPERTIES

(Annealed)

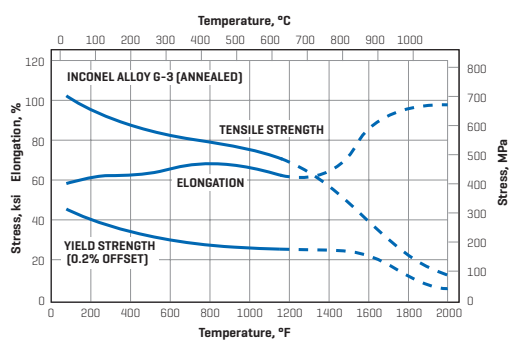
Tensile Strength, ksi.....	100
MPa.....	758
Yield Strength [0.2% Offset], ksi.....	53
MPa.....	363
Elongation, %.....	62



— Typical usage range

(Annealed)

Tensile Strength, ksi.....	100
MPa.....	690
Yield Strength [0.2% Offset], ksi.....	47
MPa.....	320
Elongation, %.....	50



— Typical usage range

INCONEL ALLOY HX

A nickel-chromium-iron-molybdenum alloy with outstanding strength and oxidation resistance at temperatures to 2200°F [1200°C]. Matrix stiffening provided by the molybdenum content results in high strength in a solid-solution alloy having good fabrication characteristics. Used in gas turbines, industrial furnaces, heat-treating equipment and nuclear engineering.

INCONEL ALLOY NO6230

A carbide strengthened nickel-chromium-tungsten alloy with an exceptional combination of strength, stability and resistance to corrosion at very high temperatures. Alloy NO6230 offers particularly good resistance to oxidation at temperatures greater than 1800°F [980°C]. It also offers good resistance to carburization and nitridation. Potential applications for this alloy include equipment and components for land-based gas turbines, thermal and petrochemical processing, heat treating, and ore refining.

STANDARD PRODUCT FORMS

Sheet, strip, plate, round bar, flat bar, forging stock, hexagon, wire and extruded section.

Contact Special Metals.

MAJOR SPECIFICATIONS

UNS N06002	SAE AMS 5536, 5587, 5588,
ASTM B 366, B 435, B 572,	5754, 5798
B 619, B 622, B 626,	Werkstoff Nr. 2.4665
B 751, B 775, B 829	NACE MR-0175/ISO 15156
ASME SB-366, SB-435, SB-572,	AECMA Pr EN 2182 - 2185
SB-619, SB-622, SB-626,	BS HR 6, HR 204
SB-751, SB-775, SB-829	ISO 6207, 6208, 9723 - 9725
DIN 17744, 17750-17754	

UNS N06230	ASME SB 435, SB 564,
W. Nr. 2.4733	SB 572, SB 619,
ASTM B 366, B 435, B 564,	SB 622, SB 626
B 572, B 619, B 622, B 626	SAE/AMS 5839, 5878, 5891

LIMITING CHEMICAL COMPOSITION, %

Ni.....Remainder	Co.....0.5 - 2.5	Mn.....1.0 max.
Cu.....20.5 - 23.0	W.....0.2 - 1.0	P.....0.04 max.
Fe.....17.0 - 20.0	C.....0.05 - 0.15	S.....0.03 max.
Mo.....8.0 - 10.0	Si.....1.0 max.	

Ni.....Remainder	W.....13.0 - 15.0	S.....0.015 max.
Fe.....3.0 max.	C.....0.05 - 0.15	Al.....0.20 - 0.50
Cr.....20.0 - 24.0	Si.....0.25 - 0.75	La..0.005 - 0.050
Co.....5.0 max.	Mn.....0.30 - 1.00	B.....0.015 max.
Mo.....1.0 - 3.0	P.....0.030 max.	

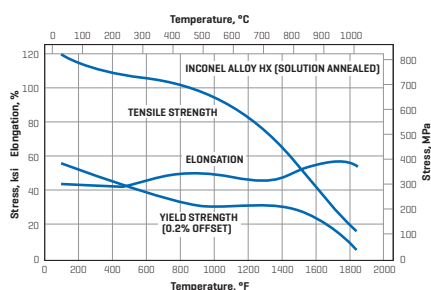
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.297
g/cm ³	8.22
Melting Point, °F.....	2300 - 2470
°C.....	1260 - 1355
Specific Heat, Btu/lb • °F.....	0.110
J/kg • °C.....	461
Permeability at 200 Oersted [15.9 kA/m].....	1.0110
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in • °F.....	7.4
20 - 100°C, μm/m • °C.....	13.3
Thermal Conductivity, Btu • in/ft ² • h • °F.....	80.4
W/m • °C.....	11.6
Electrical Resistivity, ohm • circ mil/ft.....	698
μΩ • m.....	1.16

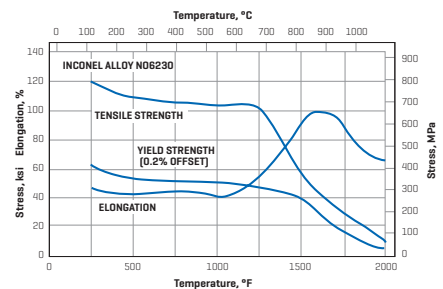
Density, lb/in ³	0.322
g/cm ³	8.91
Melting Point, °F.....	2480 - 2570
°C.....	1360 - 1410
Permeability at 200 Oersted [15.9 kA/m].....	1.002
Coefficient of Expansion, 70 - 600°F, 10 ⁻⁶ in/in • °F.....	6.9
20 - 316°C, 10 ⁻⁶ cm/cm • °C.....	12.4
Electrical Resistivity, ohm • circ mil/ft.....	759
μΩ • m.....	126
Young's Modulus, 10 ³ ksi.....	30.7
GPa.....	211
Shear Modulus, 10 ³ ksi.....	11.4
GPa.....	78.8
Poisson's Ratio.....	0.34

TYPICAL MECHANICAL PROPERTIES
[Solution Annealed]

Rupture Strength [1000h]	ksi	MPa
1400°F / 760°C.....	16.0	110
1500°F / 815°C.....	10.5	72
1600°F / 870°C.....	6.5	45
1700°F / 925°C.....	3.8	26
1800°F / 980°C.....	2.2	15


[Annealed]

Tensile Strength, ksi.....	117 - 122
MPa.....	807 - 841
Yield Strength [0.2% Offset], ksi.....	55 - 62
MPa.....	379 - 427
Elongation, %.....	44 - 48



— Typical usage range

INCOLOY ALLOY 800

A nickel-chromium alloy with good strength and excellent resistance to oxidation and carburization in high-temperature atmospheres. It also resists corrosion by many aqueous environments. The alloy maintains a stable, austenitic structure during prolonged exposure to high temperatures. Used for process piping, heat exchangers, carburizing equipment, heating-element sheathing and nuclear steam-generator tubing.

INCOLOY ALLOY 800H & 800HT

Nickel-iron-chromium alloys that have the same basic composition as INCOLOY alloy 800 but with significantly higher creep-rupture strength. The higher strength results from close control of the carbon, aluminum and titanium contents in conjunction with a high-temperature anneal. Used in chemical and petrochemical processing, power plants for super-heater and reheater tubing, industrial furnaces and heat-treating equipment.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

MAJOR SPECIFICATIONS

UNS N08800	ASME SB-163, SA-240,
BS 3072 - 3076 (NA15)	SB-366, SB-407 - SB-409,
ASTM B 163, A 240, B 366,	SA-480, SB-514, SB-515,
B 407 - B 409, A 480, B 514,	SB-564, SB-751, SB-775,
B 515, B 564, B 751,	SB-829
B 775, B 829	ASME Code Cases 1325,
DIN 470	1949, 2339, N-20
Werkstoff Nr. 1.4876	SAE AMS 5766, 5871
VdTÜV 412	NACE MR-0175/ISO 15156
	ISO 9723 - 9725, 6207, 6208

UNS N08810, N08811	ASME Code Cases 1325,
BS 3072, 3073, 3074, 3075,	1949, 1983, 2339,
3076 (NA15)	N-201, N-254
ASTM A 240, A 480, B 163,	DIN 17459, 17460
B 366, B 407 - 409,	Werkstoff Nr. 1.4876, 1.4958,
B 514, B 515, B 564,	1.4959
B 751, B 775, B 829	VdTÜV 412, 434
ASME SA-240, SA-480,	EN 10028-7, 10095
SB-163, SB-366,	ISO 4955A, 6207, 6208,
SB-407 - SB-409, SB-514,	9723, 9725
SB-515, SB-564, SB-751,	
SB-775, SB-829	

LIMITING CHEMICAL COMPOSITION, %

Ni.....30.0 - 35.0	Mn.....1.50 max.	Al.....0.15 - 0.60
Fe.....39.5 min.	S.....0.015 max.	Ti.....0.15 - 0.60
Cr.....19.0 - 23.0	Si.....1.0 max.	
C.....0.10 max.	Cu.....0.75 max.	

800H	Ni.....30.0-35.0	C.....0.05-0.10	Ti.....0.15-0.60
	Fe.....39.5 min.	Al.....0.15-0.60	Al+Ti.....0.30-1.20
	Cr.....19.0-23.0		

800HT	Ni.....30.0-35.0	C.....0.06-0.10	Ti.....0.25-0.60
	Fe.....39.5 min.	Al.....0.25-0.60	Al+Ti.....0.85-1.20
	Cr.....19.0-23.0		

*By special agreement, this product can be supplied with aluminum + titanium limited to 0.4 - 0.7%.

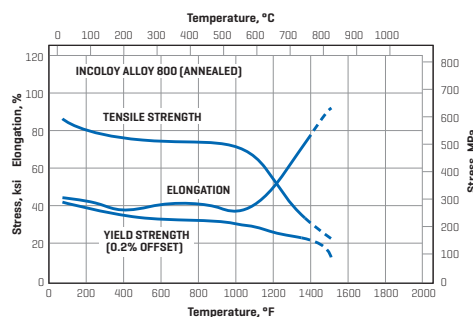
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³ [g/cm ³]	0.287 [7.94]
Melting Range, °F [°C]	2475 - 2525 [1357 - 1385]
Specific Heat, Btu/lb•°F [J/kg•°C]	0.11 [460]
Curie Temperature, °F [°C]	-175 [-115]
Permeability at 200 Oersted [15.9 kA/m]	1.014
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [µm/m•°C]	7.9 [14.4]
70-200°F [20-100°C]	
Thermal Conductivity ^A , Btu•in/ft ² •h•°F [W/m•°C]	80 [11.5]
Electrical Resistivity ^A , ohm•circ mil/ft [µΩ•m]	595 [0.989]

Density, lb/in ³ [g/cm ³]	0.287 [7.94]
Melting Range, °F [°C]	2475 - 2525 [1357 - 1385]
Specific Heat, Btu/lb•°F [J/kg•°C]	0.11 [460]
Curie Temperature, °F [°C]	-175 [-115]
Permeability at 200 Oersted [15.9 kA/m]	1.014
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [µm/m•°C]	7.9 [14.4]
70-200°F [20-100°C]	
Thermal Conductivity ^A , Btu•in/ft ² •h•°F [W/m•°C]	80 [11.5]
Electrical Resistivity ^A , ohm•circ mil/ft [µΩ•m]	595 [0.989]

TYPICAL MECHANICAL PROPERTIES
(Annealed)

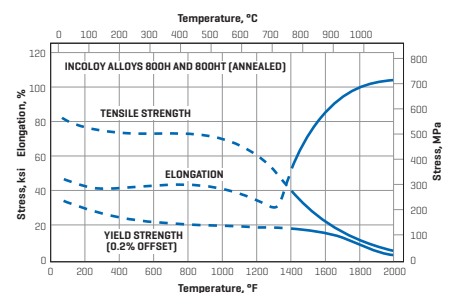
Rupture Strength [1000h]	ksi	MPa
1000°F / 540°C	48	330
1100°F / 595°C	32	220
1200°F / 650°C	21	145
1300°F / 705°C	11	75



— Typical usage range

(Annealed)

Rupture Strength [1000h]	ksi	MPa
1200°F / 650°C	24.0	165
1300°F / 705°C	15.0	105
1400°F / 760°C	10.0	70
1600°F / 870°C	4.7	32
1800°F / 980°C	2.0	14



— Typical usage range

INCOLOY ALLOY 864

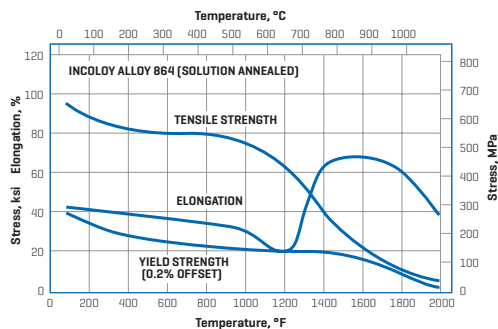
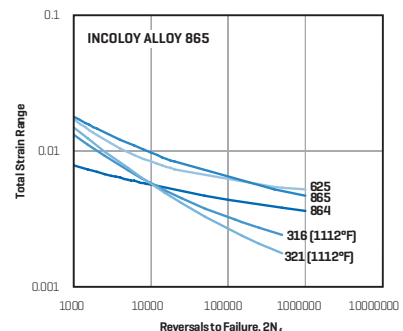
A new high-performance and cost-effective alloy specifically developed for automotive exhaust system flexible couplings. Potentially useful for exhaust gas recirculation tubes and other fabricated exhaust system components.

INCOLOY ALLOY 865

INCOLOY alloy 865 [UNS S35115] is an economical, high-performance corrosion-resistant alloy. Developed from the technology of INCOLOY alloy 864, it improved strength, ductility and fatigue resistance at reduced cost. The alloy was designed for automotive applications such as flexible couplings and exhaust gas recirculation (EGR) components. However, with its excellent combination of strength and corrosion resistance, alloy 865 may be evaluated for chemical processing and marine applications.

STANDARD PRODUCT FORMS	Sheet and strip.	Sheet and strip.
MAJOR SPECIFICATIONS	UNS S35135 ASTM A 240, A 480	UNS S35115 ASTM A240/A480
LIMITING CHEMICAL COMPOSITION, %	Ni.....30.0 – 38.0 Mo.....4.0 – 4.8 Mn.....0.01 Fe.....Remainder C.....0.08 max. S.....0.015 max. Cr.....20.0 – 25.0 Si.....0.6 – 1.0 Ti.....0.4 – 1.0	Ni.....19.0 – 22.0 N.....0.20 – 0.30 P.....0.045 max. Cr.....23.0 – 25.0 Mn.....1.0 max. S.....0.015 max. Mo.....1.50 – 2.50 C.....0.020 max.
PHYSICAL CONSTANTS AND THERMAL PROPERTIES	Density, lb/in ³0.290 g/cm ³8.02 Melting Range, °F.....2467 – 2539 °C.....1353 – 1393 Permeability at 200 Oersted [15.9 kA/m].....1.004 Coefficient of Expansion, 10 ⁻⁶ in/in•°F (μm/m•°C) 70–200°F [21–93°C].....8.15 [14.7] 70–800°F [21–427°C].....8.90 [15.9] 70–1200°F [21–649°C].....9.21 [16.4] Thermal Conductivity ^A , Btu • in/ft ² •h•°F.....78.1 W/m•°C.....11.3 Electrical Resistivity ^A , ohm • circ mil/ft.....628 μΩ • m.....1.04 Young's Modulus ^A , 10 ⁶ psi.....28.3 GPa.....195 ^A Room temperature, as annealed.	Density, lb/in ³0.276 g/cm ³7.64 Melting Range, °F.....2484 – 2535 °C.....1362 – 1390 Permeability at 200 Oersted [15.9 kA/m].....1.002 Electrical Resistivity, ohm • circ mil/ft.....553 μΩ • m.....92 Young's [Tensile] Modulus, ksi.....28.7 x 10 ³ GPa.....195

TYPICAL MECHANICAL PROPERTIES	(Solution Annealed)	(Annealed)
Tensile Strength, ksi.....	94	110
MPa.....	648	758
Yield Strength [0.2% Offset], ksi.....	40	54
MPa.....	276	372
Elongation, %.....	44	50
Reduction of Area, %.....	44	44
Hardness.....		88 HRB


**FATIGUE PROPERTIES AT 1000°F (538°C)
LONGITUDINAL STRAIN CONTROLLED**


INCOLOY ALLOY 903

A nickel-iron-cobalt alloy with additions of niobium, titanium and aluminum for precipitation hardening. The alloy combines high strength with a low and constant coefficient of thermal expansion at temperatures to about 800°F [430°C]. It also has a constant modulus of elasticity and is highly resistant to thermal fatigue and thermal shock. Used in gas turbines for rings and casings.

STANDARD PRODUCT FORMS

Sheet, plate, rod, bar and forging stock.

MAJOR SPECIFICATIONS

UNS N19903

LIMITING CHEMICAL COMPOSITION, %

Ni.....36.0 - 40.0 Co.....13.0 - 17.0 Ti.....1.00 - 1.85
Fe.....Remainder Al.....0.30 - 1.15 Nb.....2.40 - 3.50

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³.....0.298
g/cm³.....8.25
Melting Range, °F.....2405 - 2539
°C.....1318 - 1393
Specific Heat, Btu/lb•°F.....0.105
J/kg•°C.....442
Curie Temperature, °F.....780 - 880
°C.....415 - 470
Coefficient of Expansion, 77 - 800°F, 10⁻⁶ in/in•°F.....4.0
25 - 427°C, μm/m•°C.....7.2
Thermal Conductivity, Btu • in/ft²•h•°F.....116
W/m•°C.....16.7
Electrical Resistivity, ohm•circ mil/ft.....379
μΩ•m.....0.650

TYPICAL MECHANICAL PROPERTIES

[Precipitation Hardened]
Tensile Strength, ksi.....190
MPa.....1310
Yield Strength [0.2% Offset], ksi.....160
MPa.....1100
Elongation, %.....14

INCOLOY ALLOY 907

A nickel-iron-cobalt alloy with additions of niobium and titanium for precipitation hardening. It has the low coefficient of expansion and high strength of INCOLOY alloy 903 but with improved notch-rupture properties at elevated temperatures. Used for components of gas turbines including seals, shafts and casings.

Round bar and forging stock.

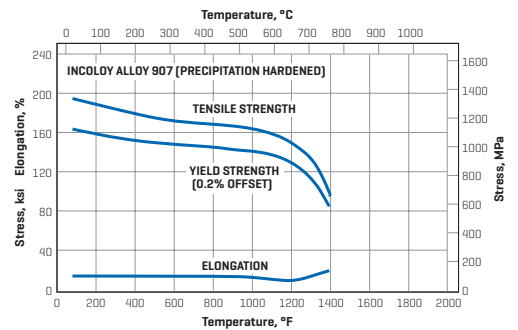
UNS N19907

Ni.....35.0 - 40.0 Nb.....4.3 - 5.2 Al.....0.2 max.
Fe.....Remainder Ti.....1.3 - 1.8 Si.....0.07 - 0.35
Cu.....12.0 - 16.0

Density, lb/in³.....0.301
g/cm³.....8.33
Melting Range, °F.....2440 - 2550
°C.....1335 - 1400
Specific Heat, Btu/lb•°F.....0.103
J/kg•°C.....431
Curie Temperature, °F.....750 - 850
°C.....400 - 455
Coefficient of Expansion, 77 - 800°F, 10⁻⁶ in/in•°F.....4.3
25 - 427°C, μm/m•°C.....7.7
Thermal Conductivity, Btu • in/ft²•h•°F.....103
W/m•°C.....14.8
Electrical Resistivity, ohm•circ mil/ft.....419
μΩ•m.....0.697

[Precipitation Hardened]

Rupture Strength (1000h)	ksi	MPa
1000°F / 540°C	100	690
1100°F / 595°C	85	590
1200°F / 650°C	50	340



INCOLOY ALLOY 909

A nickel-iron-cobalt alloy with a silicon addition containing niobium and titanium for precipitation hardening. It is similar to INCOLOY alloys 903 and 907 because it has low thermal expansion and high strength. However, the silicon addition results in improved notch-rupture and tensile properties achieved with less-restrictive processing and significantly shorter heat treatments. Used for gas-turbine casings, shrouds, vanes and shafts.

INCOLOY ALLOY 925

A precipitation-hardenable nickel-iron-chromium alloy with additions of molybdenum and copper. It combines the high strength of a precipitation-hardenable alloy with the excellent corrosion resistance of INCOLOY alloy 825. The alloy has outstanding resistance to general corrosion, pitting, crevice corrosion and stress-corrosion cracking in many aqueous environments, including those containing sulfides and chlorides. Used for surface and down-hole hardware in sour gas wells and for oil-production equipment.

STANDARD PRODUCT FORMS

Round bar, forging stock and hot-rolled profile.

Tube, round bar, flat bar, forging stock and wire.

MAJOR SPECIFICATIONS

 UNS N19909
SAE AMS 5884, 5892, 5893

 UNS N09925
NACE MR-0175/ISO 15156
ASME Code Case 2218

LIMITING CHEMICAL COMPOSITION, %

Ni..... 35.0 - 40.0	Nb 4.3 - 5.2	Al 0.15 max.
Fe..... Remainder	Ti 1.3 - 1.8	C 0.06 max.
Co..... 12.0 - 16.0	Si 0.25 - 0.50	

Ni..... 42.0 - 46.0	Mo 2.5 - 3.5	Al 0.1 - 0.5
Fe..... Remainder	Cu 1.5 - 3.0	C 0.03 max.
Cr..... 19.5 - 22.5	Ti 1.90 - 2.40	

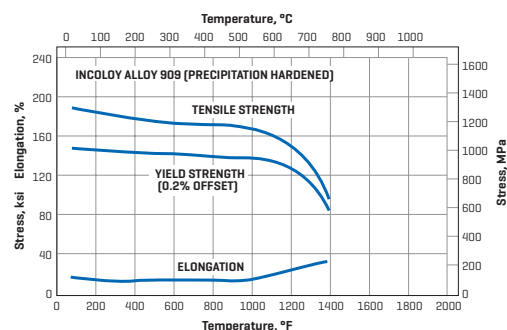
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.296
g/cm ³	8.19
Melting Range, °F.....	2540 - 2610
°C.....	1395 - 1430
Specific Heat, Btu/lb•°F.....	0.102
J/kg•°C.....	427
Curie Temperature, °F.....	750 - 850
°C.....	400 - 455
Coefficient of Expansion, 77 - 800°F, 10 ⁻⁶ in/in•°F.....	4.3
25 - 427°C, μm/m•°C.....	7.7
Thermal Conductivity, Btu • in/ft ² •h•°F.....	103
W/m•°C.....	14.8
Electrical Resistivity, ohm • circ mil/ft.....	438
μΩ • m.....	0.728

Density, lb/in ³	0.292
g/cm ³	8.08
Melting Range, °F.....	2392 - 2490
°C.....	1311 - 1366
Specific Heat, Btu/lb•°F.....	0.104
J/kg•°C.....	435
Permeability at 200 Oersted [15.9 kA/m].....	1.001
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in•°F.....	7.8
21 - 93°C, μm/m•°C.....	13.2
Electrical Resistivity, ohm • circ mil/ft.....	701
μΩ • m.....	1.17

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

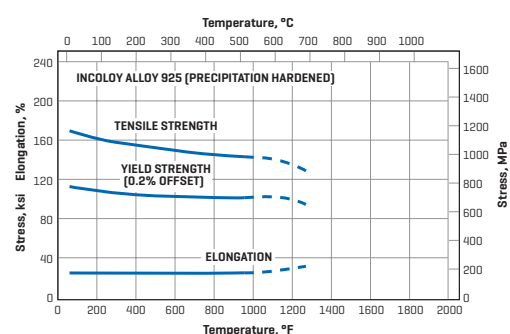
Rupture Strength (1000h)	ksi	MPa
1000°F / 540°C.....	130	900
1100°F / 595°C.....	85	590
1200°F / 650°C.....	45	310



— Typical usage range

[Precipitation Hardened]

Tensile Strength, ksi.....	176
MPa.....	1210
Yield Strength (0.2% Offset), ksi.....	118
MPa.....	810
Elongation, %.....	24



— Typical usage range

INCOLOY ALLOY 945

INCOLOY alloy 945 [UNS N09945] is a corrosion-resistant, high strength, age hardenable nickel-iron-chromium alloy. Its nickel content provides resistance to stress corrosion cracking. Its combination of nickel, molybdenum and copper gives it outstanding resistance to attack by reducing media, while its high chromium content provides resistance to oxidizing environments. Molybdenum and niobium provide resistance to localized attack such as pitting and crevice corrosion. Niobium, titanium and aluminum react upon heat treatment to precipitate gamma prime and gamma double prime phases that give the alloy its high strength. With this highly desirable combination of properties, alloy 945 is suitable for many demanding applications in oil and gas service. With resistance to sulfide-induced stress corrosion cracking and corrosion in hydrogen sulfide, alloy 945 is ideal for fabrication of down-hole and surface well equipment including tubular products, valves, hangers, landing nipples, tool joints and packers. When cold worked and aged, the alloy provides the properties required for fasteners, pump shafting and high strength piping.

INCOLOY ALLOY 945X

INCOLOY alloy 945X [UNS N09945] offers enhanced strength over that of INCOLOY alloy 945. With increased levels of hardeners in the alloy composition, alloy 945X exhibits a minimum yield strength of 140 ksi. With this higher strength, alloy 945X is especially well suited for high strength oilfield equipment as both bar and mechanical tube products.

The corrosion resistance of INCOLOY alloy 945X is comparable to that of INCOLOY alloy 945. Both alloys are approved to NACE MR0175 Level VII and Level VI-450°F. Thus, alloys 945 and 945X find applications in corrosive sour oil and gas environments containing hydrogen sulfide, free-sulfur, carbon dioxide, chlorides and other aggressive corrodents.

STANDARD PRODUCT FORMS

Bar, forging stock, tubes.

Bar, forging stock, tubes.

MAJOR SPECIFICATIONS

 UNS N09945
 NACE MR0175 [Approved to Level VII and Level VI at 450°F]

 UNS 09945
 NACE MR0175 [Approved to Level VII and Level VI at 450°F]

LIMITING CHEMICAL COMPOSITION, %

Ni.....	45.0 – 55.0	Nb.....	2.5 – 4.5	Mn.....	1.0 max.
Cr.....	19.5 – 23.0	Ti.....	0.5 – 2.5	Si.....	0.5 max.
Fe.....	Balance	Al.....	0.01 – 0.7	P.....	0.03 max.
Mo.....	3.0 – 4.0	C.....	0.005 – 0.04	S.....	0.030 max.
Cu.....	1.5 – 3.0				

Ni.....	45.0 – 55.0	Nb.....	2.5 – 4.5	Mn.....	1.0 max.
Cr.....	19.5 – 23.0	Ti.....	0.5 – 2.5	Si.....	0.5 max.
Fe.....	Balance	Al.....	0.01 – 0.7	P.....	0.03 max.
Mo.....	3.0 – 4.0	C.....	0.005 – 0.04	S.....	0.030 max.
Cu.....	1.5 – 3.0				

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.281
g/cm ³	7.777
Melting Range, °F.....	2317 – 2510
°C.....	1270 – 1377
Permeability at 200 Oersted.....	1.003
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [µm/m•°C]	
70-200°F [21-93°C].....	7.88 [14.19]
70-800°F [21-427°C].....	8.40 [15.12]
70-1200°F [21-649°C].....	8.85 [15.93]
Young's (Tensile) Modulus.....	28.3 x 10 ³ ksi
Shear Modulus.....	10.8 x 10 ³ ksi
Poisson's Ratio.....	0.31

Density, lb/in ³	0.281
g/cm ³	7.777
Melting Range, °F.....	2317 – 2510
°C.....	1270 – 1377
Permeability at 200 Oersted.....	1.003
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [µm/m•°C]	
70-200°F [21-93°C].....	7.88 [14.19]
70-800°F [21-427°C].....	8.40 [15.12]
70-1200°F [21-649°C].....	8.85 [15.93]

TYPICAL MECHANICAL PROPERTIES

[Annealed + Aged]

Minimum Tensile Strength, ksi.....	150
MPa.....	1034
Minimum Yield Strength [0.2% Offset], ksi.....	130
MPa.....	896
Minimum Elongation, %.....	18
Minimum Reduction of Area, %.....	25
Maximum Hardness.....	42HRC
Minimum Impact Strength [CVN @ - 75°F], ft lbs.....	35
Joules.....	47

[Annealed + Aged]

Minimum Tensile Strength, ksi.....	165
MPa.....	1138
Minimum Yield Strength [0.2% Offset], ksi.....	140
MPa.....	965
Minimum Elongation, %.....	18
Minimum Reduction of Area, %.....	25
Maximum Hardness.....	42HRC
Minimum Impact Strength [CVN @ - 75°F], ft lbs.....	30
Joules.....	41

INCOLOY ALLOY 20

A nickel-iron-chromium alloy with additions of copper and molybdenum. It also contains niobium for stabilization against sensitization and resultant intergranular corrosion. The alloy has excellent resistance to general corrosion, pitting and crevice corrosion in chemicals containing chlorides and sulfuric, phosphoric and nitric acids. Used for tanks, piping, heat exchangers, pumps, valves and other process equipment.

INCOLOY ALLOY 28

INCOLOY alloy 28 [UNS N08028] is a highly corrosion-resistant austenitic alloy offering resistance to a variety of media. The alloy resists attack in reducing media due to its contents of nickel, copper and molybdenum and is resistant to oxidizing species due to its high level of chromium. Alloy 28 offers resistance to general, localized and stress-induced corrosion by chlorides and hydrogen sulfides. Thus, it is widely used in oilfield applications. Tubes are cold worked to high levels of strength for downhole service in deep sour gas wells. With its excellent combination of strength and corrosion resistance, alloy 28 also finds applications in the process industries. It is especially useful for handling phosphoric acid. Due to its resistance to chlorides, alloy 28 tubes may be used in the marine industry for seawater-cooled heat exchangers.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

Tube.

MAJOR SPECIFICATIONS

UNS N08020	ASME SA-240, SA-480, SB-366,
ASTM A 240, A 480, B 366,	SB-462 - SB-464,
B 462 - 464, B 468,	SB-468, SB-471 - SB-475,
B 471 - B 475, B 729, B 751,	SB-729, SB-751, SB-775,
B 775, B 829, B 906	SB-829, SB-906
DIN 17744, 17750-17754	ISO 6207, 6208, 9723 - 9725

UNS N08028	Werkstoff Nr. 1.4563
ASTM B 668, B 709, B 829	NACE MR-01-75
ASME SB-668, SB-709, SB-829	

LIMITING CHEMICAL COMPOSITION, %

Ni 32.0 - 38.0	Nb+Ta ... 8xC-1.0	Mn 2.0 max.
Fe Remainder	Mo 2.0 - 3.0	P 0.045 max.
Cr 19.0 - 21.0	Nb 1.0 max.	S 0.035 max.
Cu 3.0 - 4.0	C 0.07 max.	Si 1.0 max.

Ni 30.0 - 34.0	Fe Balance	S 0.030 max.
Cr 26.0 - 28.0	Mn 2.50 max.	Si 1.00 max.
Mo 3.0 - 4.0	C 0.030 max.	
Cu 0.6 - 1.4	P 0.030 max.	

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.292
g/cm ³	8.08
Specific Heat, Btu/lb•°F	0.12
J/kg•°C	500
Coefficient of Expansion, 77 - 212°F, 10 ⁻⁶ in/in•°F	8.2
25 - 100°C, μm/m•°C	14.7
Thermal Conductivity, Btu • in/ft ² •h•°F	85
W/m•°C	12.3
Electrical Resistivity, ohm • circ mil/ft	651
μΩ • m	1.08

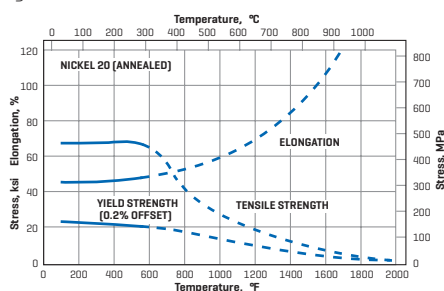
Density, lb/in ³ [g/cm ³]	0.29 [8.0]
Specific Heat, Btu/lb•°F [J/kg•°C]	0.105 [450]
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [μm/m•°C]	
75-200°F [21-93°C]	8.3 [15.0]
75-500°F [21-260°C]	8.8 [15.9]
75-800°F [21-427°C]	9.3 [16.8]
Thermal Conductivity ^A , Btu • in/ft ² •h•°F	66
W/m•°C	11.4
Electrical Resistivity ^A , ohm • circ mil/ft [μΩ • m]	594 [0.99]
Young's Modulus ^A , 10 ⁶ psi [GPa]	29.0 [200]

^ARoom temperature, as annealed.

TYPICAL MECHANICAL PROPERTIES

[Annealed]

Tensile Strength, ksi	90
MPa	620
Yield Strength [0.2% Offset], ksi	45
MPa	300
Elongation, %	40



— Typical usage range

[Annealed]

Tensile Strength, ksi	73
MPa	500
Yield Strength [0.2% Offset], ksi	31
MPa	214
Elongation, %	40
Hardness, [HRB]	70/90

[Cold Worked]

Tensile Strength, ksi	130
MPa	896
Yield Strength [0.2% Offset], ksi	110
MPa	758
Elongation, %	15
Hardness, [HRC]	33 max.

INCOLOY ALLOY 330

A nickel-iron-chromium alloy with an addition of silicon for enhanced oxidation resistance. It has good strength at high temperatures and excellent resistance to carburizing and oxidizing atmospheres. The alloy's austenitic microstructure remains stable during long-time exposure to high temperature. Used in industrial heating for furnace muffles, retorts, conveyor systems and heat-treating baskets and fixtures.

INCOLOY ALLOY 25-6MO

A super-austenitic containing 6% molybdenum and offering excellent corrosion-resistance to neutral and acidic environments containing chlorides or other halides, such as what is found in air pollution control and flue gas desulfurization systems. The molybdenum and nitrogen content provide resistance to pitting and crevice corrosion, while copper enhances resistance to sulfuric acid. The alloy is especially suited for service in high-chloride environments such as brackish water, seawater, caustic chlorides and pulp mill bleach systems.

STANDARD PRODUCT FORMS

Tube, sheet, strip, plate, round bar, forging stock, hexagon, wire, and wire rod.

Pipe, tube, sheet, strip, plate, round bar, forging stock and wire.

MAJOR SPECIFICATIONS

UNS N08330
 ASTM B 366, B 511, B 512, B 535, B 536, B 546, B 710, B 739, B 829
 SAE AMS 5592, 5716

ASME SB-366, SB-511, SB-512, SB-535, SB-536, SB-546, SB-710, SB-739, SB-829
 Werkstoff Nr. 1.4886

UNS N08925, N08926
 ASTM A 240, A 480, B 366, B 472, B 625, B 649, B 673, B 674, B 677, B 751, B 775, B 804, B 829
 W. Nr. 1.4529

ASME SA-240, SA-480, SB-366, SB-472, SB-625, SB-649, SB-673, SB-674, SB-677, SB-751, SB-775, SB-804, SB-829
 ASME Code Cases 2120, N-453, N-454, N-455

LIMITING CHEMICAL COMPOSITION, %

Ni..... 34.0 - 37.0 Si..... 0.75 - 1.50 P..... 0.30 max.
 Fe..... Remainder C..... 0.08 max. Si..... 0.30 max.
 Cr..... 17.0 - 20.0 Mn..... 2.0 max.

Ni..... 24.0 - 26.0 Cu..... 0.5 - 1.5 P..... 0.03 max.
 Fe..... Remainder N..... 0.15 - 0.25 S..... 0.01 max.
 Cr..... 19.0 - 21.0 C..... 0.02 max. Si..... 0.5 max.
 Mo..... 6.0 - 7.0 Mn..... 2.0 max.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

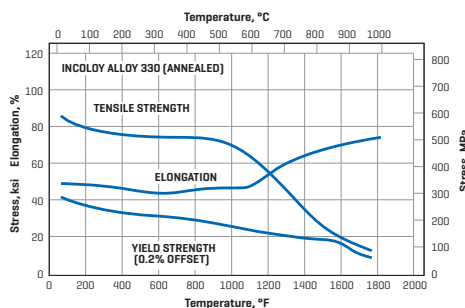
Density, lb/in³..... 0.292
 g/cm³..... 8.08
 Melting Range, °F 2520 - 2590
 °C 1380 - 1420
 Specific Heat, Btu/lb•°F 0.11
 J/kg•°C..... 460
 Permeability at 200 Oersted [15.9 kA/m] 1.02
 Coefficient of Expansion, 10⁻⁶ in/in•°F [µm/m•°C]
 75-200°F [24-93°C]..... 8.3 [14.9]
 Thermal Conductivity, Btu • in/ft²•h•°F 86
 W/m•°C..... 12.4
 Electrical Resistivity, ohm•circ mil/ft..... 612
 µΩ•m..... 1.017

Density, lb/in³ [g/cm³]..... 0.290 [8.03]
 Melting Range, °F [°C]..... 2410 - 2550 [1320 - 1400]
 Specific Heat, Btu/lb•°F [J/kg•°C]..... 0.12 [500]
 Permeability at 200 Oersted [15.9 kA/m] 1.005
 Coefficient of Expansion, 10⁻⁶ in/in•°F [µm/m•°C]
 70-200°F [21-93°C]..... 8.42 [15.2]
 70-800°F [21-427°C]..... 9.12 [16.4]
 70-1200°F [21-649°C]..... 9.41 [16.9]
 Thermal Conductivity^A, Btu • in/ft²•h•°F..... 79.8
 W/m•°C 11.5
 Electrical Resistivity^A, ohm•circ mil/ft 480
 µΩ•m 0.80
 Young's Modulus^A, 10⁶ psi [GPa] 27.3 [188]
^ARoom temperature, as annealed.

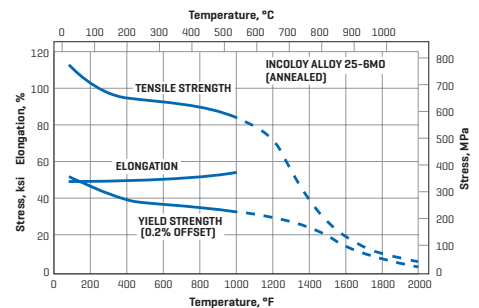
TYPICAL MECHANICAL PROPERTIES

(Annealed)		ksi	MPa
Rupture Strength (1000h)			
1400°F / 760°C		7.0	48
1600°F / 870°C		3.1	21
1800°F / 980°C		1.25	8.6
2000°F / 1095°C		0.78	5.4

(Annealed)		ksi	MPa
Tensile Strength			
		100	690
Yield Strength (0.2% Offset)			
		48	330
Elongation, %			
		42	



— Typical usage range



— Typical usage range

INCOLOY ALLOY 25-6HN

INCOLOY alloy 25-6HN is a super-austenitic stainless steel containing 6% molybdenum with properties enhanced by its content of nitrogen. Its high content of nickel results in thermal stability and resistance to stress corrosion cracking. Designated as UNS N08367, alloy 25-6HN directly competes with alloy AL6XN®1. The same ASTM, ASME and NACE specifications cover the alloys. Alloy 25-6HN offers significantly improved strength and corrosion resistance in most environments over conventional austenitic stainless steels such as AISI 304 or 316L. Typical applications include welded tubes for heat exchangers for both chemical processing and marine applications and for desalination systems, flue gas desulfurization equipment for coal-fired power plants and reaction vessels for pharmaceutical production.

1“AL6XN” is a registered trademark of Allegheny Ludlum Corporation.

INCOLOY ALLOY 27-7MO

An advanced 7% molybdenum super-austenitic stainless steel offering corrosion resistance in most environments superior to 6% molybdenum super-austenitic stainless steels. In many environments, alloy 27-7MO offers resistance approaching or exceeding that of much more highly alloyed materials such as INCONEL alloys 625, 22 and C-276. Applications for this alloy are found in the pollution control, power, marine, chemical processing, pulp and paper, pharmaceutical and oil and gas industries.

STANDARD PRODUCT FORMS

Sheet, strip, plate, round bar, wire rod and forging stock.

Sheet, plate, bar and wire.

MAJOR SPECIFICATIONS

UNS N08367
ASTM B688, A240, B691, B564, B472, B676, B675, B804, B462, B366
ASME SB688, SA240, SB691, SB564, SB472, SB676, SB675, SB804, SB462, SB366

UNS S31277
ASTM A 182, A 213, A 240, A 249, A 312, A 479
ASME SA 182, SA 213, SA 240 SA 249, SA 312, SA 479
ASME Code Case 2458

LIMITING CHEMICAL COMPOSITION, %

Ni.... 23.50-25.50 N..... 0.18-0.25 Si.....1.00 max.
Cr... 20.00-22.00 Cu.....0.75 max. P..... 0.040 max.
Fe.....Balance C.....0.03 max. S..... 0.030 max.
Mo.....6.00-7.00 Mn.....2.00 max

Ni..... 26.0 - 28.0 N.....0.3-0.4 S.....0.01 max.
Cr..... 20.5 - 23.0 Fe.....Remainder Si..... 0.5 max.
Mo..... 6.5 - 8.0 Mn.....3.00 max. C..... 0.020 max.
Cu.....0.5-1.5 P.....0.03 max.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³.....0.291
g/cm³..... 8.06
Melting Range, °F2470 - 2550
°C1320 - 1400
Permeability at 200 Oersted.....1.003
Coefficient of Expansion, 10⁻⁶ in/in • °F
70 - 200°F..... 8.66
70 - 800°F 9.05
70 - 1200°F 9.53

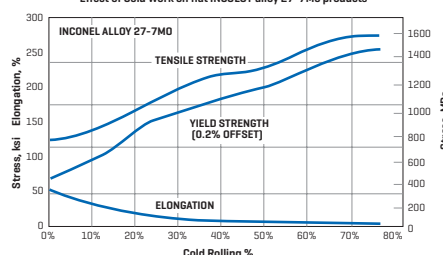
Density, lb/in³ [g/cm³].....0.289 [8.02]
Specific Heat, Btu/lb • °F [J/kg • °C].....0.109 [454]
Permeability at 200 Oersted [15.9 kA/m]1.004
Coefficient of Expansion, 10⁻⁶ in/in • °F [μm/m • °C]
70-200°F [21-93°C]..... 8.33 [15.0]
Thermal Conductivity, Btu • in/ft² • h • °F [W/m • °C] 69.8 [10.1]
Electrical Resistivity, ohm • circ mil/ft [μΩ • cm]604 [100]
Young's Modulus, 10⁶ psi [GPa].....27.7 [191]
Shear Strength, 10⁶ psi [GPa].....10.8 [74]
Poisson's Ratio 0.29
Melting Range, °F [°C].....2460 - 2530 [1350 - 1390]

TYPICAL MECHANICAL PROPERTIES

[Annealed]
Tensile Strength, ksi..... 108
MPa..... 744
Yield Strength [0.2% Offset], ksi.....55
MPa..... 381
Elongation, %48
Hardness90HRB

[Annealed]
Tensile Strength, ksi..... 120
MPa..... 827
Yield Strength [0.2% Offset], ksi.....60
MPa..... 414
Elongation, %50

Effect of Cold Work on flat INCOLOY alloy 27-7Mo products



INCOLOY ALLOY A-286

An alloy that is precipitation hardenable for high mechanical properties. The alloy maintains good strength and oxidation resistance at temperatures up to about 1300°F (700°C). The alloy's high strength and excellent fabrication characteristics make it useful for various components of aircraft and industrial gas turbines. Applications include blades, vanes, shafts, tail cones, afterburners, springs and fasteners. This alloy is also used for automotive applications.

STANDARD PRODUCT FORMS

Sheet, strip, plate, round bar, flat bar, forging stock, hexagon and wire.

MAJOR SPECIFICATIONS

UNS S66286	BS HR 51, HR 52, HR 650
ASTM A 453, A 638	AECMA Pr EN 2119,
ASME SA-453, SA-638	2171 - 2175, 2303, 2304,
SAE AMS 5525, 5726,	2398, 2399, 2417, 3510
5731, 5732, 5734, 5737,	NACE MR-0175/ISO 15156
5858, 5895, 7235	W. NR. 1.4980

LIMITING CHEMICAL COMPOSITION, %

Ni..... 24.0 - 27.0	Mo..... 1.0 - 1.5	Si..... 1.0 max.
Cr..... 13.5 - 16.0	V..... 0.10 - 0.50	Al..... 0.35 max.
Fe..... Balance	C..... 0.08 max.	S..... 0.030 max.
Ti..... 1.90 - 2.35	Mn..... 2.0 max.	B..... 0.001 - 0.01

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.287
g/cm ³	7.94
Melting Range, °F.....	2500 - 2600
°C.....	1370 - 1430
Specific Heat, Btu/lb•°F.....	0.100
J/kg•°C.....	419
Permeability at 200 Oersted [15.9 kA/m].....	1.007
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [µm/m•°C]	
70 - 200°F [21- 93°C].....	9.09 [16.4]
70 - 800°F [21- 427°C].....	9.61 [17.3]
70 - 1400°F [21-760°C].....	9.67 [17.4]
Thermal Conductivity ^A , Btu • in/ft ² •h•°F.....	88
W/m•°C.....	12.7
Electrical Resistivity ^A , ohm•circ mil/ft.....	547
µΩ•m.....	0.910
Young's Modulus ^A , 10 ⁶ psi.....	29.1
GPa.....	201
Hardness ^A , HRC.....	31

^ARoom temperature, as annealed.

INCOLOY ALLOY 890

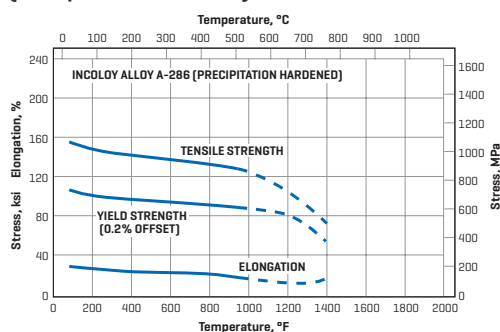
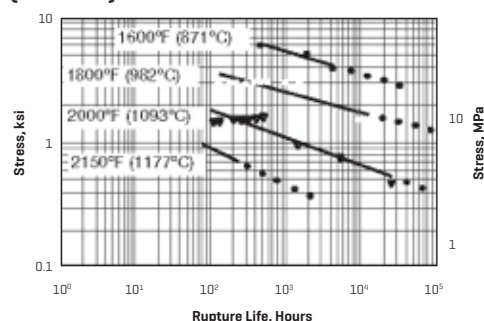
INCOLOY® alloy 890 [UNS N08890] is the latest addition to the INCOLOY alloy family of heat-resistant alloys. Alloy 890 joins existing INCOLOY products in offering high strength along with excellent resistance to oxidation, carburization and sulfidation at temperatures up to 2200°F (1200°C). Alloy 890 offers the high chromium content of alloy 803 along with enhanced properties from additions of molybdenum, silicon and niobium. The primary application for alloy 890 is tubes for ethylene pyrolysis furnaces.

Smooth bore tubes; Internally finned tubes

UNS N08890
ASTM B407, 408, 409

Ni..... 40.0 - 45.0	Nb..... 0.2 - 1.0	Mn..... 1.5 max.
Cr..... 23.5 - 28.5	Ta..... 0.10 - 0.60	Cu..... 0.75 max.
Fe..... Balance	Ti..... 0.15 - 0.60	P..... 0.03 max.
Mo..... 1.0 - 2.0	Al..... 0.05 - 0.60	S..... 0.015 max.
Si..... 1.0 - 2.0	C..... 0.06 - 0.14	

Density, lb/in ³	0.287
g/cm ³	7.94
Coefficient of Expansion, 10 ⁻⁶ in/in•°F [µm/m•°C]	
70-200°F [21- 100°C].....	8.02 [14.47]
70-600°F [21- 300°C].....	8.43 [15.11]
70-1000°F [21- 600°C].....	8.94 [16.40]
Thermal Conductivity, Btu • in/ft ² •h•°F.....	550
W/m•°C.....	10.98
Electrical Resistivity, ohm•circ mil/ft.....	212.47
µΩ•cm.....	1033
Modulus of Elasticity*, 10 ⁶ psi [GPa].....	28.3 [195.1]
Shear Modulus*, 10 ⁶ psi [GPa].....	10.7 [73.8]
Poisson's Ratio*.....	0.322
Melting Range, °F [°C].....	2388 - 2522 [1309 - 1383]

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

[Annealed]


NIMONIC ALLOY 75

A nickel-chromium alloy with good mechanical properties and oxidation resistance at high temperatures. Used for sheet-metal fabrications in gas-turbine engines, components of industrial furnaces, heat-treating equipment and fixtures, and nuclear engineering.

NIMONIC ALLOY 80A

A nickel-chromium alloy similar to NIMONIC alloy 75 but made precipitation hardenable by additions of aluminum and titanium. The alloy has good corrosion and oxidation resistance and high tensile and creep-rupture properties at temperatures to 1500°F (815°C). Used for gas-turbine components (blades, rings and discs), bolts, tube supports in nuclear steam generators, die-casting inserts and cores, and exhaust valves in internal-combustion engines.

STANDARD PRODUCT FORMS

Sheet, strip, plate, round bar, forging stock, wire and extruded section.

Sheet, round bar, flat bar, forging stock, hexagon, wire, extruded section and plate.

MAJOR SPECIFICATIONS

UNS N06075
BS HR5, HR203, HR403, HR504
DIN 17742, 17750 - 17752
Werkstoff Nr. 2.4951, 2.4630
ISO 6207, 6208, 9723-9725

AECMA Pr EN 2293, 2294,
2302, 2306 - 2308,
2402, 2411

UNS N07080
BS 3076 (NA20), HR1,
HR201, HR401, HR601
ASTM B 637
AIR 9165-37

DIN 17742
Werkstoff Nr. 2.4952, 2.4631
AECMA Pr EN 2188 - 2191,
2396, 2397

LIMITING CHEMICAL COMPOSITION, %

Ni.....Remainder C.....0.08 - 0.15 Fe..... 5.0 max.
Cr..... 18.0 - 21.0 Si..... 1.0 max. Mn..... 1.0 max.
Ti..... 0.2 - 0.6 Cu..... 0.5 max.

Ni.....Remainder Si..... 1.0 max. B..... 0.008 max.
Cr..... 18.0 - 21.0 Cu..... 0.2 max. Zr..... 0.15 max.
Ti..... 1.8 - 2.7 Fe..... 3.0 max. S..... 0.015 max.
Al..... 1.0 - 1.8 Mn..... 1.0 max.
C..... 0.10 max. Co..... 2.0 max.

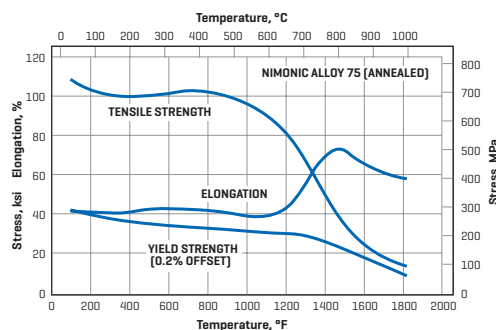
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³.....0.302
g/cm³..... 8.37
Melting Range, °F2440 - 2520
°C1340 - 1380
Specific Heat, Btu/lb•°F0.110
J/kg•°C..... 461
Coefficient of Expansion, 68 - 212°F 10⁻⁶ in/in•°F.....6.1
20 - 100°C, µm/m•°C 11.0
Thermal Conductivity, Btu • in/ft²•h•°F 81.1
W/m•°C..... 11.7
Electrical Resistivity, ohm•circ mil/ft..... 656
µΩ•m 1.09

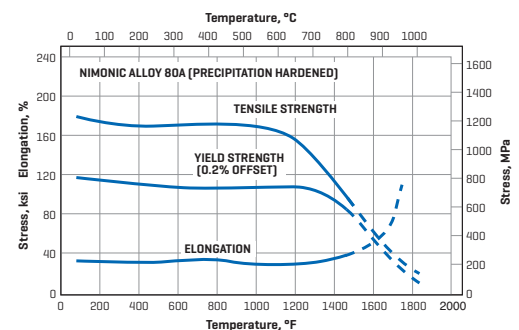
Density, lb/in³.....0.296
g/cm³..... 8.19
Melting Range, °F2410 - 2490
°C1320 - 1365
Specific Heat, Btu/lb•°F0.107
J/kg•°C..... 448
Permeability at 200 Oersted [15.9 kA/m]1.0006
Coefficient of Expansion, 68 - 212°F, 10⁻⁶ in/in•°F..... 7.1
20 - 100°C, µm/m•°C 12.7
Thermal Conductivity, Btu • in/ft²•h•°F 77.7
W/m•°C..... 11.2
Electrical Resistivity, ohm•circ mil/ft..... 746
µΩ•m 1.24

TYPICAL MECHANICAL PROPERTIES
(Annealed)

Rupture Strength (1000h)	ksi	MPa
1400°F / 760°C.....	6.0	40
1500°F / 815°C.....	3.5	24
1600°F / 870°C.....	2.2	15
1700°F / 925°C.....	1.5	10
1800°F / 980°C.....	1.2	8


(Precipitation Hardened)

Rupture Strength (1000h)	ksi	MPa
1100°F / 595°C.....	94	650
1200°F / 650°C.....	73	500
1300°F / 705°C.....	51	350
1400°F / 760°C.....	32	220
1500°F / 815°C.....	16	110



NIMONIC ALLOY 86

A nickel-chromium-molybdenum alloy with a rare-earth [cerium] addition. It combines good formability and weldability with exceptional resistance to oxidation and scaling at temperatures to 1920°F [1050°C]. Used in gas turbines for sheet-metal fabrications such as combustion chambers and afterburners and in heat-treating furnaces.

NIMONIC ALLOY 90

A precipitation-hardenable nickel-chromium-cobalt alloy having high stress-rupture strength and creep resistance at temperatures to about 1700°F [920°C]. The alloy also has good resistance to high-temperature corrosion and oxidation. Used for blades and discs in gas turbines, hot-working tools and springs.

STANDARD PRODUCT FORMS

Sheet, strip, plate, round bar, forging stock, extruded sections and wire.

Sheet, strip, plate, round bar, flat bar, forging stock, wire and extruded section.

MAJOR SPECIFICATIONS

None applicable.

UNS N07090	AECMA Pr EN
BS HR2, HR202, HR402, HR501 - HR503	2295 - 2299, 2400, 2401, 2669, 2670
Werkstoff Nr. 2.4632	

LIMITING CHEMICAL COMPOSITION, %

Nominal
 Ni65 Mo..... 10.0 C..... 0.05
 Cr 25.0 Ce 0.03

Limiting
 Ni.....Remainder C.....0.13 max. B.....0.02 max.
 Cr.....18.0 - 21.0 Si.....1.0 max. S.....0.015 max.
 Co.....15.0 - 21.0 Cu.....0.2 max. Zr.....0.15 max.
 Ti.....2.0 - 3.0 Fe.....1.5 max.
 Al.....1.0 - 2.0 Mn.....1.0 max.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³.....0.309
 g/cm³.....8.54
 Young's Modulus, 10⁶ psi.....30.5
 GPa210
 Coefficient of Expansion, 68 - 212°F, 10⁻⁶ in/in•°F.....7.1
 20 - 100°C, μm/m•°C12.7

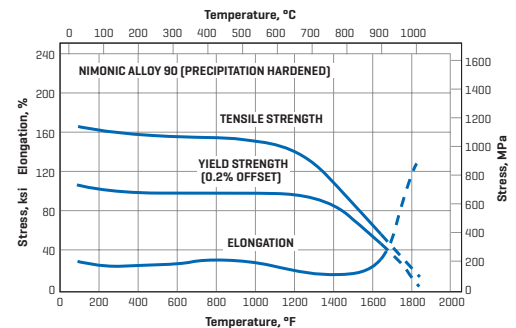
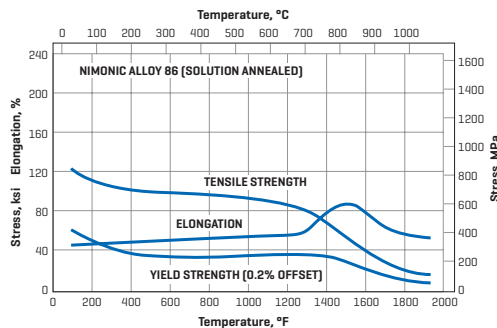
Density, lb/in³.....0.296
 g/cm³.....8.18
 Melting Range, °F2390 - 2500
 °C1310 - 1370
 Specific Heat, Btu/lb•°F0.107
 J/kg•°C.....446
 Permeability at 200 Oersted [15.9 kA/m]1.0706
 Coefficient of Expansion, 68 - 212°F, 10⁻⁶ in/in•°F.....7.1
 20 - 100°C, μm/m•°C12.7
 Thermal Conductivity, Btu • in/ft²•h•°F79.7
 W/m•°C.....11.5
 Electrical Resistivity, ohm • circ mil/ft.....710
 μΩ • m1.18

TYPICAL MECHANICAL PROPERTIES
[Solution Annealed]

Rupture Strength [1000h]	ksi	MPa
1500°F / 815°C.....	11.6	80
1600°F / 870°C.....	7.3	50
1700°F / 925°C.....	4.1	28
1800°F / 980°C.....	2.6	18

[Annealed]

Rupture Strength [1000h]	ksi	MPa
1300°F / 705°C.....	52	360
1400°F / 760°C.....	35	240
1500°F / 815°C.....	22	150
1600°F / 870°C.....	11	75



— Typical usage range

NIMONIC ALLOY 263

A precipitation-hardenable nickel-chromium-cobalt alloy with an addition of molybdenum for solid-solution strengthening. It has high strength and corrosion resistance along with good formability and high-temperature ductility in welded structures. The alloy is especially suitable for sheet applications. Used in gas turbines for rings, casings and various sheet fabrications.

NIMONIC ALLOY 901

A nickel-iron-chromium alloy containing titanium and aluminum for precipitation hardening and molybdenum for solid-solution strengthening. The alloy has high-yield strength and creep resistance at temperatures to about 1110°F [600°C]. A substantial iron content enables the alloy to combine high strength with good forging characteristics. Used in gas turbines for discs and shafts.

STANDARD PRODUCT FORMS

Sheet, strip, plate, round bar, flat bar, forging stock, wire and extruded section.

Flat or round bar, extruded section and forging billet.

MAJOR SPECIFICATIONS

UNS N07263
BS HR10, HR206, HR404
SAE AMS 5872
DIN 17744, 17750-17754

AECMA Pr EN
2199 - 2203, 2418
Werkstoff Nr. 2.4650

UNS N09901
BS HR55
SAE AMS 5660, 5661

AECMA Pr EN 2176 - 2178
Werkstoff Nr. 2.4662
ISO 9723, 9725

LIMITING CHEMICAL COMPOSITION, %

Ni.....Remainder	Al.....0.60 max.	S.....0.007 max.
Cr.....19.0 - 21.0	Ti+Al.....2.4 - 2.8	B.....0.005 max.
Co.....19.0 - 21.0	C.....0.04 - 0.08	Cu.....0.20 max.
Mo.....5.6 - 6.1	Si.....0.40 max.	Fe.....0.7 max.
Ti.....1.9 - 2.4	Mn.....0.60 max.	

Ni ^a40.0 - 45.0	Ti.....2.8 - 3.1	Cu.....0.5 max.
Fe.....Remainder	Al.....0.35 max.	Mn.....0.5 max.
Cr.....11.0 - 14.0	C.....0.1 max.	Co.....1.0 max.
Mo.....5.0 - 6.5	Si.....0.4 max.	S.....0.03 max.

^aPlus Co.

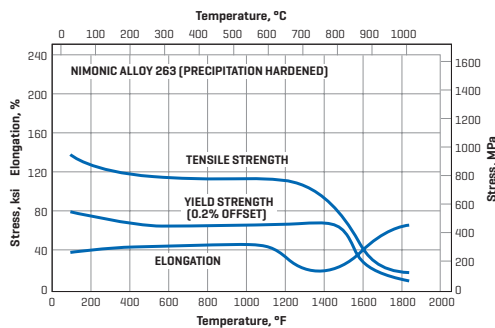
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³.....0.302
g/cm³.....8.36
Melting Range, °F.....2370 - 2470
°C.....1300 - 1355
Specific Heat, Btu/lb•°F.....0.110
J/kg•°C.....461
Permeability at 200 Oersted [15.9 kA/m].....1.0008
Coefficient of Expansion, 68 - 212°F, 10⁻⁶ in/in•°F.....5.7
20 - 100°C, μm/m•°C.....10.3
Thermal Conductivity, Btu • in/ft²•h•°F.....81.1
W/m•°C.....11.7
Electrical Resistivity, ohm • circ mil/ft.....692
μΩ • m.....1.15

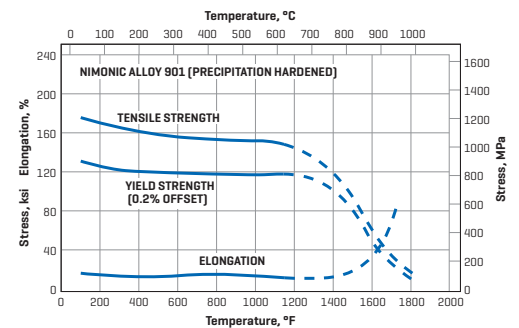
Density, lb/in³.....0.294
g/cm³.....8.14
Melting Range, °F.....2335 - 2455
°C.....1280 - 1345
Specific Heat, Btu/lb•°F.....0.103
J/kg•°C.....431
Permeability at 200 Oersted [15.9 kA/m].....1.013
Coefficient of Expansion, 68 - 212°F, 10⁻⁶ in/in•°F.....7.5
20 - 100°C, μm/m•°C.....13.5
Electrical Resistivity, ohm • circ mil/ft.....674
μΩ • m.....1.12

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

Rupture Strength (1000h)	ksi	MPa
1100°F / 600°C.....	81.8	564
1290°F / 700°C.....	38.1	263
1470°F / 800°C.....	16.8	116
1560°F / 850°C.....	8.7	60
1650°F / 900°C.....	5.2	36


[Precipitation Hardened]

Rupture Strength (1000h)	ksi	MPa
1000°F / 540°C.....	116	800
1100°F / 595°C.....	87	600
1200°F / 650°C.....	65	450
1300°F / 705°C.....	44	300
1400°F / 760°C.....	29	200



— Typical usage range

NIMONIC ALLOY PE11

A nickel-iron-chromium alloy precipitation hardened by titanium and aluminum and solid-solution strengthened by an addition of molybdenum. It was developed as a high-strength sheet alloy for use at temperatures to 1020°F [550°C]. The high iron content provides good workability and also relatively high tensile ductility, especially after welding. Used for components of gas turbines.

NIMONIC ALLOY PE16

A precipitation-hardenable nickel-iron-chromium alloy with an addition of molybdenum for solid-solution strengthening. It has good strength and oxidation resistance at temperatures to about 1380°F [750°C]. The alloy is designed to provide a precipitation-hardened material having excellent hot-working, cold-working and welding characteristics. Used for gas-turbine components and nuclear reactors.

STANDARD PRODUCT FORMS

Sheet, plate, round bar, flat bar, forging stock and wire.

Sheet, plate, round bar, flat bar, forging stock, and extruded section.

MAJOR SPECIFICATIONS

None Applicable.

BS HR55, HR207

LIMITING CHEMICAL COMPOSITION, %

Ni..... 37.0 – 41.0	Al..... 0.7 – 1.0	Co..... 1.0 max.
Fe..... Remainder	C..... 0.03 – 0.08	B..... 0.001 max.
Cr..... 17.0 – 19.0	Si..... 0.5 max.	Zr..... 0.02 – 0.05
Mo..... 4.75 – 5.75	Cu..... 0.5 max.	S..... 0.015 max.
Ti..... 2.2 – 2.5	Mn..... 0.2 max.	

Ni ^a 42.0 – 45.0	Ti..... 1.1 – 1.3	Mn..... 0.2 max.
Fe..... Remainder	Al..... 1.1 – 1.3	Co..... 2.0 max.
Cr..... 15.5 – 17.5	C..... 0.04 – 0.08	B..... 0.005 max.
Mo..... 2.8 – 3.8	Si..... 0.5 max.	Zr..... 0.02 – 0.04
^a Plus Co.	Cu..... 0.5 max.	S..... 0.015 max.

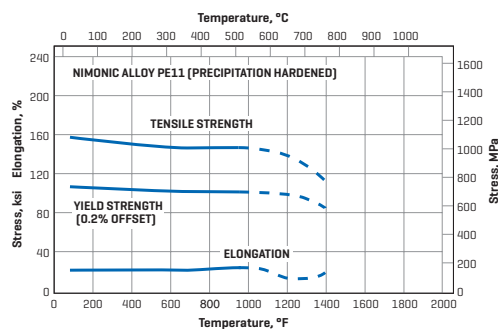
PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.290
g/cm ³	8.02
Melting Range, °F.....	2340 – 2460
°C.....	1280 – 1350
Specific Heat, Btu/lb•°F.....	0.104
J/kg•°C.....	436
Permeability at 300 Oersted [23.9 kA/m].....	1.021

Density, lb/in ³	0.289
g/cm ³	8.00
Melting Range, °F.....	2390 – 2470
°C.....	1310 – 1355
Specific Heat, Btu/lb•°F.....	0.130
J/kg•°C.....	544
Permeability at 200 Oersted [15.9 kA/m].....	1.4
Coefficient of Expansion, 68 – 212°F, 10 ⁻⁶ in/in•°F.....	7.7
20 – 100°C, μm/m•°C.....	13.8
Thermal Conductivity, Btu • in/ft ² •h•°F.....	81.26
W/m•°C.....	11.72
Electrical Resistivity, ohm • circ mil/ft.....	662
μΩ • m.....	1.10

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

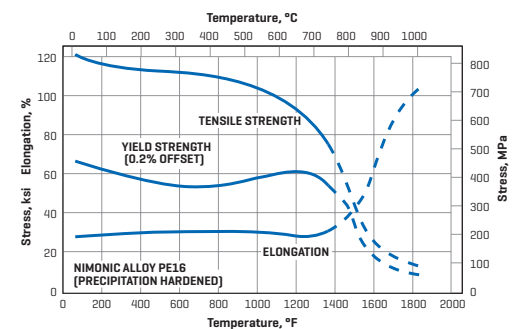
Rupture Strength (1000h)	ksi	MPa
1200°F / 650°C.....	49	340
1300°F / 705°C.....	36	250
1400°F / 760°C.....	21	140



— Typical usage range

[Precipitation Hardened]

Rupture Strength (1000h)	ksi	MPa
1200°F / 650°C.....	52.6	363
1290°F / 700°C.....	37.0	255
1380°F / 750°C.....	22.5	155



— Typical usage range

NIMONIC ALLOY PK33

A nickel-chromium-cobalt alloy that is precipitation hardenable and also contains a relatively high [7%] level of molybdenum for solid-solution strengthening. It has an exceptional combination of high-temperature strength, creep resistance and ductility when welded. The alloy is especially suitable for welded sheet structures. Used in gas turbines for flame tubes and other components.

NIMONIC ALLOY MP35N

NIMONIC alloy MP35N is a multi-phase, cobalt-base alloy offering a unique combination of ultra-high strength, toughness and corrosion resistance. Common applications are fasteners, springs and high strength components for marine, oil and gas, and chemical processing service.

STANDARD PRODUCT FORMS

Sheet, plate, round bar, flat bar, forging stock, and extruded section.

Cold drawn tube

MAJOR SPECIFICATIONS

None applicable.

UNS R30035
BS 3072 - 3074 (NA12)
SAE AMS 5758, 5844, 5845, 7468

ASTM F1636, F2005, F2068, F366, F688, F961

LIMITING CHEMICAL COMPOSITION, %

Ni.....Remainder	Al.....1.7 - 2.5	Mn.....0.5 max.
Cr.....16.0 - 20.0	C.....0.07 max.	S.....0.015 max.
Co.....12.0 - 16.0	Si.....0.5 max.	B.....0.005 max.
Mo.....5.0 - 9.0	Cu.....0.2 max.	Zr.....0.06 max.
Ti.....1.5 - 3.0	Fe.....1.0 max.	

Ni.....33.0 - 37.0	Fe.....1.0 max.	Mn.....0.15 max.
Cr.....19.0 - 21.0	Si.....0.15 max.	P.....0.015 max.
Co.....Balance	Ti.....1.0 max.	S.....0.010 max.
Mo.....9.0 - 10.5	C.....0.025 max.	

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³.....0.297
g/cm³.....8.21
Melting Range, °F.....2340 - 2450
°C.....1300 - 1345
Specific Heat, Btu/lb•°F.....0.100
J/kg•°C.....419
Permeability at 200 Oersted (15.9 kA/m).....1.0005
Coefficient of Expansion, 68 - 212°F, 10⁻⁶ in/in•°F.....6.7
20 - 100°C, μm/m•°C.....12.1
Thermal Conductivity, Btu • in/ft²•h•°F.....78.3
W/m•°C.....11.3
Electrical Resistivity, ohm•circ mil/ft.....758
μΩ•m.....1.26

Density, lb/in³.....0.304
g/cm³.....8.43
Coefficient of Expansion, 10⁻⁶ in/in•°F (μm/m•°C)
70-200°F [21-93°C].....7.1 [12.8]
70-600°F [21-316°C].....8.2 [14.8]
70-1000°F [21-538°C].....8.7 [15.7]
Thermal Conductivity, Btu • in/ft²•h•°F.....78
W/m•°C.....11.2
Electrical Resistivity, μΩ•in.....40.7
μΩ•mm.....1033
Modulus of Elasticity^A, 10⁶ psi [GPa].....33.8 [233]
Modulus of Rigidity^A, 10⁶ psi [GPa].....11.7 [81]
Shear Modulus^A, 10⁶ psi [GPa].....12.1 [84]
Magnetic Permeability^A.....1.001
Melting Range, °F.....2340 - 2450
°C.....1300 - 1345

^ARoom temperature, as annealed

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

Rupture Strength [1000h]	ksi	MPa
1200°F / 650°C.....	87	600
1300°F / 705°C.....	65	450
1400°F / 760°C.....	44	300
1500°F / 815°C.....	26	180
1600°F / 870°C.....	15	100

[Annealed]

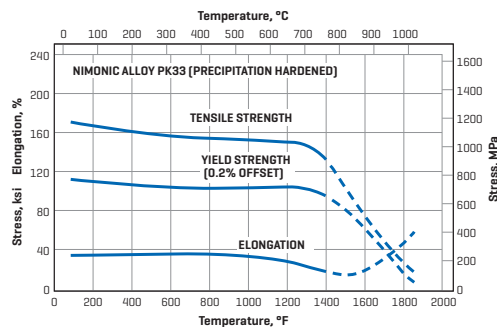
Tensile Strength, ksi.....120 - 140
MPa.....827 - 965
Yield Strength [0.2% Offset], ksi.....40 - 60
MPa.....276 - 414
Elongation, %.....40 - 60

[Cold Worked]

Tensile Strength, ksi.....160 - 260
MPa.....1103 - 1792
Yield Strength [0.2% Offset], ksi.....120 - 240
MPa.....827 - 1655
Elongation, %.....10 - 30

[Cold Worked + Aged]

Tensile Strength, ksi.....180 - 280
MPa.....1241 - 1930
Yield Strength [0.2% Offset], ksi.....170 - 270
MPa.....1172 - 1861
Elongation, %.....10 - 20



— Typical usage range

NILO ALLOY 36

A nickel-iron low-expansion alloy containing 36% nickel. It maintains nearly constant dimensions over the range of normal atmospheric temperatures, and has a low coefficient of expansion from cryogenic temperatures to about 500°F [260°C]. The alloy also retains good strength and toughness at cryogenic temperatures. Used for standards of length, measuring devices, laser components, bi-metal thermostat strip, thermostat rods and tanks and piping for storing and transporting liquefied gases.

NILO ALLOY 42

A nickel-iron controlled-expansion alloy containing 42% nickel. It has a low and nominally constant coefficient of thermal expansion from room temperature to about 570°F [300°C]. Used for semiconductor lead frames in integrated circuits, bi-metal thermostat strip, thermostat rods, for ceramic-to-metal seals with alumina ceramics and various glass-to-metal seals such as: the core of copper-clad wire for sealing into glass envelopes of electric bulbs, radio valves, television tubes and fluorescent lights.

STANDARD PRODUCT FORMS

Pipe, tube, sheet, plate, round bar, forging stock and wire.

Strip, plate and wire.

MAJOR SPECIFICATIONS

 UNS K93600, K93601
 DIN 385, 1715
 Werkstoff Nr. 1.3912

 UNS K94100
 ASTM F 29, F 30
 DIN 385, 17745

Werkstoff Nr. 1.3917

LIMITING CHEMICAL COMPOSITION, %

Ni..... 35.0 – 38.0	P..... 0.025 max.	Mo..... 0.50 max.
Fe..... Remainder	S..... 0.025 max.	Co..... 1.0 max.
C..... 0.10 max.	Si..... 0.35 max.	
Mn..... 0.60 max.	Cr 0.50 max.	

Limiting

Ni..... 42 ^a	P..... 0.025 max.	Al..... 0.15 max.
Fe..... Remainder	S..... 0.025 max.	Co..... 1.0 max.
C..... 0.05 max.	Si..... 0.30 max.	
Mn..... 0.80 max.	Cr..... 0.25 max.	

^aNominal value; adjusted to meet expansion requirements.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

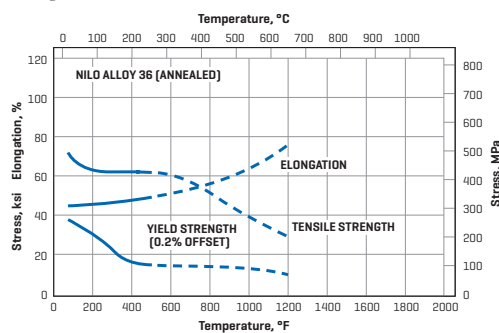
Density, lb/in ³	0.293
g/cm ³	8.11
Melting Temperature [Approximate], °F.....	2610
°C.....	1430
Inflection Point, °F.....	430
°C.....	220
Thermal Conductivity, Btu • in/ft ² •h•°F.....	69.3
W/m•°C.....	10.0
Coefficient of Expansion, 68 - 212°F, 10 ⁻⁶ in/in•°F.....	0.83
20 - 100°C, μm/m •°C.....	1.5
68 - 392°F, 10 ⁻⁶ in/in•°F.....	1.4
20 - 200°C, μm/m •°C.....	2.6
Electrical Resistivity, ohm • circ mil/ft.....	480
μΩ • m.....	0.800

Density, lb/in ³	0.293
g/cm ³	8.11
Melting Temperature [Approximate], °F.....	2615
°C.....	1435
Inflection Point, °F.....	700
°C.....	370
Thermal Conductivity, Btu • in/ft ² •h•°F.....	72.8
W/m•°C.....	10.5
Coefficient of Expansion, 68 - 212°F, 10 ⁻⁶ in/in•°F.....	2.9
20 - 100°C, μm/m •°C.....	5.3
68 - 572°F, 10 ⁻⁶ in/in•°F.....	2.5 – 3.6
20 - 300°C, μm/m •°C.....	4.5 – 6.5
Electrical Resistivity, ohm • circ mil/ft.....	370
μΩ • m.....	0.610

TYPICAL MECHANICAL PROPERTIES

(Annealed)

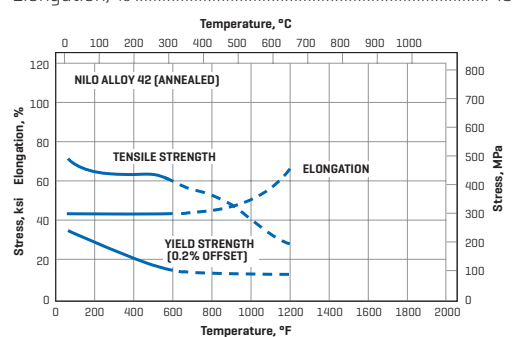
Tensile Strength, ksi.....	71
MPa.....	490
Yield Strength [0.2% Offset], ksi.....	35
MPa.....	240
Elongation, %.....	42



— Typical usage range

(Annealed)

Tensile Strength, ksi.....	71
MPa.....	490
Yield Strength [0.2% Offset], ksi.....	36
MPa.....	250
Elongation, %.....	43



— Typical usage range

WASPALLOY

Waspaloy is a nickel-base, age-hardenable superalloy with excellent high-temperature strength and good resistance to corrosion—notably to oxidation. It is used for aerospace and gas turbine engine components at service temperatures up to 1200°F [650°C] for critical rotating applications, and up to 1600°F [870°C] for other, less demanding applications. Applications include compressor and rotor discs, shafts, spacers, seals, rings and casings, fasteners and other miscellaneous engine hardware, airframe assemblies and missile systems.

Round bar, forging stock, extruded section and wire.

STANDARD PRODUCT FORMS
MAJOR SPECIFICATIONS

UNS N07001	SAE AMS 5544, 5704, 5706 -
ASTM B 637	5709, 5828, MAM 5706
Werkstoff Nr. 2.4654	AECMA Pr EN 2193 - 2195,
ISO 9723 - 9725	2406, 2958 - 2960, 3220

LIMITING CHEMICAL COMPOSITION, %

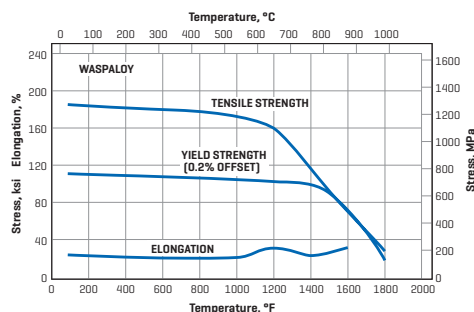
Limiting		
NiRemainder	Al1.20 - 1.60	Cu..... 0.50 max.
Cr.....18.0 - 21.0	Zr.....0.02 - 0.12	S..... 0.030 max.
Co.....12.0 - 15.0	B..... 0.003 - 0.01	Si.....0.75 max.
Mo.....3.50 - 5.00	C.....0.02 - 0.10	Mn.....1.00 max.
Ti.....2.75 - 3.25	Fe..... 2.00 max.	P..... 0.030 max.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³ [g/cm³]0.296 [8.19]
 Melting Range, °F [°C]..... 2425 - 2475 [1330 - 1360]
 Permeability at 200 Oersted [15.9 kA/m]1.004
 Coefficient of Expansion, 10⁻⁶ in/in•°F [μm/m•°C]
 70-200°F [21-93°C].....6.8 [12.2]
 70-1000°F [21-538°C]..... 7.7 [13.9]
 70-2000°F [21-1093°C]..... 10.4 [18.7]
 Electrical Resistivity^a, ohm•circ mil/ft [μΩ•m]722 [1.20]
 Young's Modulus^a, 10⁶ psi [GPa] 30.6 [211]
 Hardness^a, HRC34 - 40
^aRoom temperature, as aged.

TYPICAL MECHANICAL PROPERTIES

[Precipitation Hardened]		
Rupture Strength [1000h]	ksi	MPa
1200°F / 649°C.....	89	615
1300°F / 704°C.....	65	450
1400°F / 760°C.....	42	290
1500°F / 816°C.....	26	180
1600°F / 870°C.....	16	110



— Typical usage range

UDIMET ALLOY 188

A cobalt-base alloy with excellent high temperature strength and good oxidation resistance to 2000°F [1093°C]. The high chromium level coupled with small additions of lanthanum produce an extremely tenacious and protective scale. The alloy also has good sulfidation resistance and excellent metallurgical stability displayed by its ductility after prolonged exposure to elevated temperatures. Fabricability and weldability combine to make the alloy useful in typical gas turbine applications such as combustors, flame holders, liners and transition ducts.

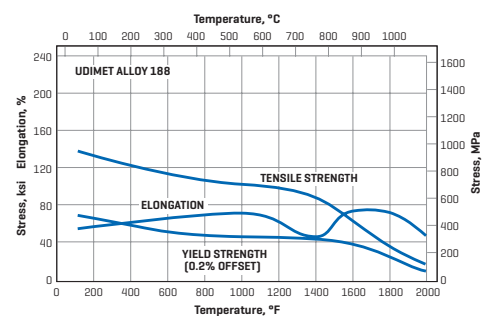
Forging billet, bar, plate, and sheet.

UNS R30188	AMS 5772
AMS 5608	

Limiting		
C.....0.05 - 0.15	Ni.....20.0 - 24.0	Fe..... 3.0 max.
Mn.....1.25 max.	W.....13.0 - 16.0	Co..... Balance
Si.....0.2 - 0.5	La.....0.02 - 0.12	B..... 0.015 max.
Cr.....20.0 - 24.0		

Density, lb/in³0.330
 g/cm³..... 9.13
 Melting Range, °F2375 - 2425
 °C1300 - 1330
 Specific Heat, Btu/lb•°F0.097
 J/kg•°C..... 405
 Coefficient of Expansion, 70 - 200°F, 10⁻⁶ in/in•°F.....6.6
 21 - 93°C, μm/m•°C..... 11.9
 Thermal Conductivity, Btu • in/ft²•h•°F84
 W/m•°C..... 12.1

Rupture Strength [1000h]	ksi	MPa
1300°F / 704°C.....	35	240
1400°F / 760°C.....	24	165
1500°F / 816°C.....	16	110
1600°F / 871°C.....	10	69
1700°F / 927°C.....	6	41
1800°F / 982°C.....	3	25
1900°F / 1038°C.....	2	15
2000°F / 1093°C.....	1	9



— Typical usage range

UDIMET ALLOY L-605

A cobalt-base superalloy with good formability, high strength to 1500°F (816°C) and oxidation resistance to 2000°F (1093°C). The alloy also has good sulfidation resistance and resistance to wear and galling. The alloy is used in the hot sections of aircrafts and in land-based gas turbines in their combustor liners as well as other applications requiring moderate strength and oxidation resistance at high temperatures. The alloy can also be used in industrial furnace applications such as muffles/liners in high temperature kilns.

UDIMET ALLOY 520

A precipitation hardenable nickel-base super-alloy with an exceptional combination of high temperature mechanical properties, corrosion resistance and forgeability characteristics. Developed for use in the 1400-1700°F (760-927°C) temperature range, the alloy has excellent structural stability and unusually good fabricability. Primary application is blading for aircraft and land-based gas turbines.

STANDARD PRODUCT FORMS

Forging billet, bar, sheet, plate and wire.

Forging bar.

MAJOR SPECIFICATIONS

UNS R30605 AMS 5537, 5796, 5797 AMS 5759

PDS 15125A1

LIMITING CHEMICAL COMPOSITION, %

Limiting
 Ni 9.0 – 11.0 Mn.....1.0 – 2.0 S.....0.03 max.
 Cr..... 19.0 – 21.0 Si.....0.40 max. Co..... Balance
 W..... 14.0 – 16.0 C.....0.05 – 0.15
 Fe..... 3.0 max.

Limiting
 C..... 0.02 – 0.06 Mo..... 5.5 – 7.0 W..... 0.8 – 1.2
 Cr..... 18.0 – 20.0 Ti..... 2.9 – 3.25 B... 0.004 – 0.010
 Co..... 11.0 – 14.0 Al..... 1.8 – 2.3 Ni..... Balance

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³ 0.335
 g/cm³ 9.27
 Melting Range, °F 2425 – 2570
 °C 1330 – 1410
 Specific Heat, Btu/lb•°F 0.092
 J/kg•°C 385
 Coefficient of Expansion, 70 – 200°F, 10⁻⁶ in/in•°F.... 6.83
 21 – 93°C, µm/m•°C 12.3
 Thermal Conductivity, Btu • in/ft²•h•°F 65
 W/m•°C 9.4

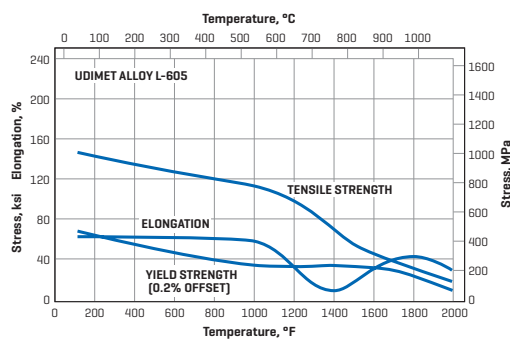
Density, lb/in³ 0.297
 g/cm³ 8.21
 Melting Range, °F 2300 – 2560
 °C 1260 – 1405

TYPICAL MECHANICAL PROPERTIES

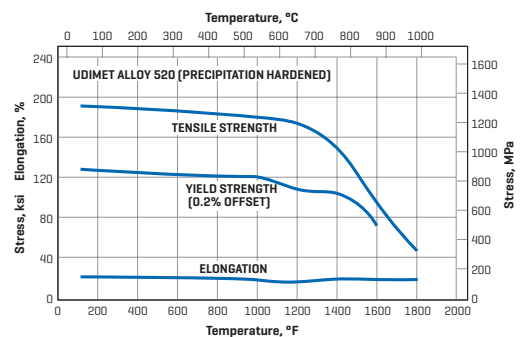
Rupture Strength (1000h)	ksi	MPa
1200°F / 649°C	39	270
1300°F / 704°C	32	220
1400°F / 760°C	24	165
1500°F / 816°C	17	120
1600°F / 871°C	10	72
1700°F / 927°C	6	44
1800°F / 982°C	4	25

[Precipitation Hardened]

Rupture Strength (1000h)	ksi	MPa
1200°F / 649°C	85	585
1300°F / 704°C	69	475
1400°F / 760°C	50	345
1500°F / 816°C	33	230
1600°F / 871°C	22	150



— Typical usage range



— Typical usage range

UDIMET ALLOY 720

A nickel-base alloy solid solution strengthened with tungsten and molybdenum and precipitation hardened with titanium and aluminum. The alloy combines high strength with metallurgical stability, as demonstrated by excellent impact strength retention after long exposures at elevated temperatures. Good oxidation and corrosion resistance combined with high strength make the alloy useful in gas turbine blades and disc applications.

STANDARD PRODUCT FORMS

Forging billet and bar.

MAJOR SPECIFICATIONS

EMS 55477	MSRR 7252	MTS 5013
EMS 73105	C50TF105	

LIMITING CHEMICAL COMPOSITION, %

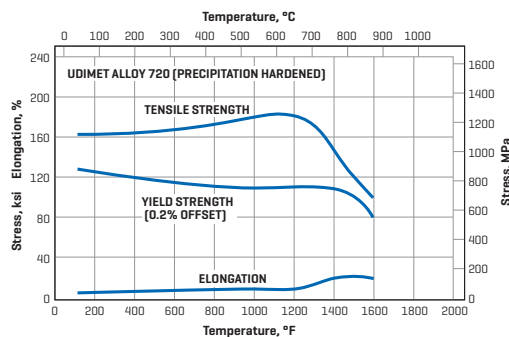
Limiting		
Ni..... Balance	W..... 1.00 - 1.50	C..... 0.01 - 0.02
Cr..... 15.5 - 16.5	Ti..... 4.75 - 5.25	Zr... 0.025 - 0.05
Co..... 14.0 - 15.5	Al..... 2.25 - 2.75	B..... 0.01 - 0.02
Mo..... 2.75 - 3.25		

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in ³	0.292
g/cm ³	8.08
Melting Range, °F.....	2180 - 2440
°C.....	1194 - 1338
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in •°F.....	6.8
21 - 93°C, µm/m •°C.....	12.24

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

Rupture Strength [1000h]	ksi	MPa
1200°F / 649°C.....	102	700
1300°F / 704°C.....	73	500
1400°F / 760°C.....	70	480
1600°F / 871°C.....	32	219
1800°F / 982°C.....	10	68



— Typical usage range

UDIMET ALLOY D-979

An iron-nickel alloy designed for turbine disc applications at temperatures up to 1200–1400°F (649–760°C). Hardened by a complex precipitation of intermetallic phases, the alloy combines corrosion resistance with excellent tensile and stress rupture strength.

Forging billet and bar.

UNS N09979	AMS 5746
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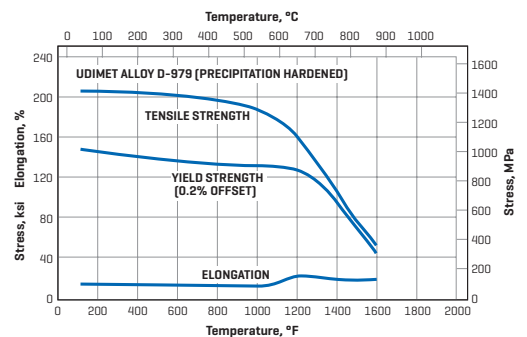
Limiting

Cr..... 14.0 - 16.0	W..... 3.0 - 4.5	C..... 0.08 max.
Fe..... Balance	Ti..... 2.7 - 3.3	Si..... 0.75 max.
Mo..... 3.0 - 4.5	Al..... 0.75 - 1.3	Mn..... 0.75 max.
Ni..... 42.0 - 48.0	B... 0.008 - 0.016	

Density, lb/in ³	0.296
g/cm ³	8.19
Melting Range, °F.....	2225 - 2530
°C.....	1220 - 1390
Coefficient of Expansion, 70 - 200°F, 10 ⁻⁶ in/in •°F.....	7.60
21 - 93°C, µm/m •°C.....	13.7
Thermal Conductivity, Btu • in/ft ² • h •°F.....	87
W/m •°C.....	12.6

[Precipitation Hardened]

Rupture Strength [1000h]	ksi	MPa
1200°F / 649°C.....	75	515
1300°F / 704°C.....	55	380
1400°F / 760°C.....	36	250
1500°F / 816°C.....	21	145
1600°F / 871°C.....	10	69



— Typical usage range

UDIMET ALLOY R41

A precipitation hardenable nickel-chromium alloy containing significant amounts of cobalt and molybdenum, along with lesser amounts of aluminum and titanium. It exhibits extremely high room and elevated temperature mechanical properties. Excellent corrosion resistance and fabricability have led to wide usage in critical aircraft engine components such as nozzle partitions, turbine blades and wheels, combustion chamber liners and structural hardware.

STANDARD PRODUCT FORMS

Forging billet, bar, sheet and plate.

MAJOR SPECIFICATIONS

UNS N 07041 AMS 5712
AMS 5545 AMS 5713

LIMITING CHEMICAL COMPOSITION, %

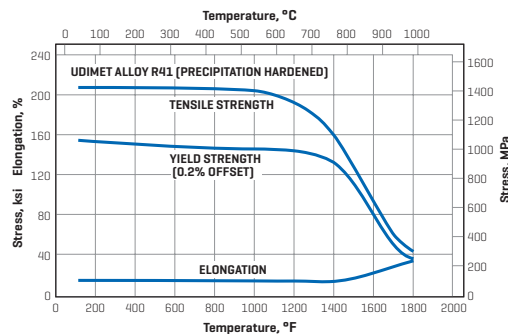
Limiting
Ni Balance Mo..... 9.0 - 10.5 Fe..... 5.0 max.
Cr..... 18.0 - 20.0 Al..... 1.40 - 1.80 B... 0.003 - 0.010
Co..... 10.0 - 12.0 Ti 3.0 - 3.3 C..... 0.12 max.

PHYSICAL CONSTANTS AND THERMAL PROPERTIES

Density, lb/in³ 0.298
g/cm³ 8.25
Melting Range, °F 2250 - 2535
°C 1232 - 1391
Specific Heat, Btu/lb•°F 0.104
J/kg•°C 435
Coefficient of Expansion, 70 - 200°F, 10⁻⁶ in/in•°F 6.63
21 - 93°C, μm/m•°C 11.9
Thermal Conductivity, Btu • in/ft²•h•°F 62
W/m•°C 9.0

TYPICAL MECHANICAL PROPERTIES
[Precipitation Hardened]

Rupture Strength (1000h)	ksi	MPa
1200°F / 649°C	102	705
1300°F / 704°C	80	550
1400°F / 760°C	50	345
1500°F / 816°C	29	200
1600°F / 871°C	17	117
1700°F / 927°C	11	76



— Typical usage range

INCOTHERM ALLOY TD

A nickel-chromium alloy that was originally developed for thermocouple sheathing where high temperature corrosion resistance and strength are required without the use of elements that may cause thermocouple degradation over time, the alloy has now been identified for uses in other high temperature and heat-treating applications. This product has been tailored to provide improved oxidation resistance over stainless steels and higher nickel alloys at temperatures up to 2282°F [1250°C] and possibly beyond. The alloying additions improve oxide scale adherence and reduce the rate of mass change, allowing the alloy to show significant improvements over alloys currently being used in heat treating applications. INCOTHERM alloy TD has excellent resistance to nitridation up to 2151°F [1177°C]. Lacking the alloying elements that form internal nitrides such as Nb or Al, the product exhibits freedom from microstructural degradation in nitrogen-based atmospheres. Because of this excellent resistance to nitridation, the alloy is being evaluated for use in powder metallurgy sintering furnace belts and other thermal processing applications as well as thermocouple sheathing.

Contact Special Metals

Nominal

Cr 22 Fe 1.0 max. C 0.05 max.
Ni Balance Mn 0.10 max. Rare earth
Mo 3 Al 0.10 max. elements 0.05
Si 1.4

Density, lb/in³ [g/cm³] 0.308 [8.54]
Melting Range, °F [°C] 2516 - 2552 [1380 - 1400]
Coefficient of Expansion, 10⁻⁶ in/in•°F [μm/m•°C]
70-932°F [21-500°C] 8.09 [14.56]
70-1112°F [21-600°C] 8.32 [14.98]
70-1292°F [21-700°C] 8.66 [15.59]
70-1472°F [21-800°C] 8.97 [16.15]
70-1652°F [21-900°C] 9.34 [16.81]
70-1832°F [21-1000°C] 9.61 [17.30]
Electrical Resistivity, ohm•circ mil/ft [μΩ•m] 698 [1.16]

Mechanical Properties INCOTHERM alloy TD

Temp. [°C]	0.2% YS [MPa]	UTS [MPa]	Elong [%]
22	405	799	51
800	177	279	82
900	75	131	80
1000	39	88	83
1100	20	59	156
1200	10	37	79
1250	8	29	95

SELECTED CONVERSION FACTORS FOR U.S. CUSTOMARY TO SI METRIC UNITS

To convert from	to	multiply by
atmosphere [760 mm Hg]	pascal [Pa]	$1.013\ 25 \times 10^5$
Btu [International Table]	joule [J]	$1.055\ 056 \times 10^3$
Btu/h	watt [W]	$2.930\ 711 \times 10^{-1}$
Btu/lb•°F	J/kg•°C	$4.186\ 8 \times 10^3$
Btu•in/ft ² •h•°F	W/m•°C	$1.442\ 279 \times 10^{-1}$
calorie	joule [J]	4.186 8
circular mil	square metre [m ²]	$5.067\ 075 \times 10^{-10}$
foot	metre [m]	$3.048\ 000 \times 10^{-1}$
ft ²	square metre [m ²]	$9.290\ 304 \times 10^{-2}$
ft ³	cubic metre [m ³]	$2.831\ 685 \times 10^{-2}$
ft•lbf	joule [J]	1.355 818
ft•lbf/min	watt [W]	$2.259\ 697 \times 20^{-2}$
ft/s ²	m/s ²	$3.048\ 000 \times 10^{-1}$
gallon [U.S. liquid]	cubic metre [m ³]	$3.785\ 412 \times 10^{-3}$
horsepower [electric]	watt [W]	$7.460\ 000 \times 10^2$
inch	metre [m]	$2.540\ 000 \times 10^{-2}$
in ²	square metre [m ²]	$6.451\ 600 \times 10^{-4}$
in ³	cubic metre [m ³]	$1.638\ 706 \times 10^{-5}$
inch of mercury [60°F]	pascal [Pa]	$3.375\ 85 \times 10^3$
inch of water [60°F]	pascal [Pa]	$2.488\ 4 \times 10^2$
kgf/cm ²	pascal [Pa]	$9.806\ 650 \times 10^4$
kip [1000 lbf]	newton [N]	$4.448\ 222 \times 10^3$
kip/in ² [ksi]	pascal [Pa]	$6.894\ 757 \times 10^8$
oersted	A/m	$7.957\ 75 \times 10$
ohm•circ mil/ft	Ω•m	$1.662\ 426 \times 10^{-9}$
ounce [U.S. fluid]	cubic metre [m ³]	$2.957\ 353 \times 10^{-5}$
ounce-force	newton [N]	$2.780\ 139 \times 10^{-1}$
ounce [avoirdupois]	kilogram [kg]	$2.834\ 952 \times 10^{-2}$
pint [U.S. liquid]	cubic metre [m ³]	$4.731\ 765 \times 10^{-4}$
pound-force [lbf]	newton [N]	4.448 222
pound [lb avoirdupois]	kilogram [kg]	$4.535\ 924 \times 10^{-1}$
lbf/in ² [psi]	pascal [Pa]	$6.894\ 757 \times 10^3$
lb/in ³	kg/m ³	$2.767\ 990 \times 10^4$
lb/ft ³	kg/m ³	1.601 846 × 10
quart [U.S. liquid]	cubic metre [m ³]	$9.463\ 529 \times 10^{-4}$
ton [short, 2000 lb]	kilogram [kg]	$9.071\ 847 \times 10^2$
torr [mm Hg, 0°C]	pascal [Pa]	$1.333\ 22 \times 10^2$
W•h	joule [J]	$3.600\ 000 \times 10^3$
yard	metre [m]	$9.144\ 000 \times 10^{-1}$
yd ²	square metre [m ²]	$8.361\ 274 \times 10^{-1}$
yd ³	cubic metre [m ³]	$7.645\ 549 \times 10^{-1}$

GRAIN-SIZE EQUIVALENTS

ASTM Number	Average Grain Diameter	
	in.	mm
00	0.020	0.508
0	0.0141	0.359
1	0.010	0.254
2	0.007	0.180
3	0.005	0.127
4	0.0035	0.089
5	0.0025	0.064
6	0.0018	0.045
7	0.0012	0.032
8	0.0009	0.022
9	0.0006	0.016
10	0.0004	0.011

MILLIMETRE—INCH EQUIVALENTS

mm	in	mm	in
1 = 0.039	14 = 0.551		
2 = 0.079	15 = 0.590		
3 = 0.118	16 = 0.630		
4 = 0.157	17 = 0.669		
5 = 0.197	18 = 0.709		
6 = 0.236	19 = 0.748		
7 = 0.276	20 = 0.787		
8 = 0.315	11 = 0.827		
9 = 0.354	22 = 0.866		
10 = 0.394	23 = 0.906		
11 = 0.433	24 = 0.945		
12 = 0.472	25 = 0.984		
13 = 0.512	26 = 1.024		

DECIMAL AND METRIC EQUIVALENTS OF FRACTIONS OF AN INCH

in	in	mm	in	in	mm
1/32 = 0.03125	= 0.794		17/32 = 0.53125	= 13.494	
1/16 = 0.0625	= 1.588		9/16 = 0.5625	= 14.287	
3/32 = 0.09375	= 2.381		19/32 = 0.59375	= 15.081	
1/8 = 0.125	= 3.175		5/8 = 0.625	= 15.875	
5/32 = 0.15625	= 3.969		21/32 = 0.65625	= 16.669	
3/16 = 0.1875	= 4.762		11/16 = 0.6875	= 17.462	
7/32 = 0.21875	= 5.556		23/32 = 0.71875	= 18.256	
1/4 = 0.25	= 6.350		3/4 = 0.75	= 19.050	
9/32 = 0.28125	= 7.144		25/32 = 0.78125	= 19.844	
5/16 = 0.3125	= 7.937		13/16 = 0.8125	= 20.637	
11/32 = 0.34375	= 8.731		27/32 = 0.84375	= 21.431	
3/8 = 0.375	= 9.525		7/8 = 0.875	= 22.225	
13/32 = 0.40625	= 10.319		29/32 = 0.90625	= 23.018	
7/16 = 0.4375	= 11.112		15/16 = 0.9375	= 23.812	
15/32 = 0.46875	= 11.906		31/32 = 0.96875	= 24.606	
1/2 = 0.5	= 12.700		1 = 1.0	= 25.4	

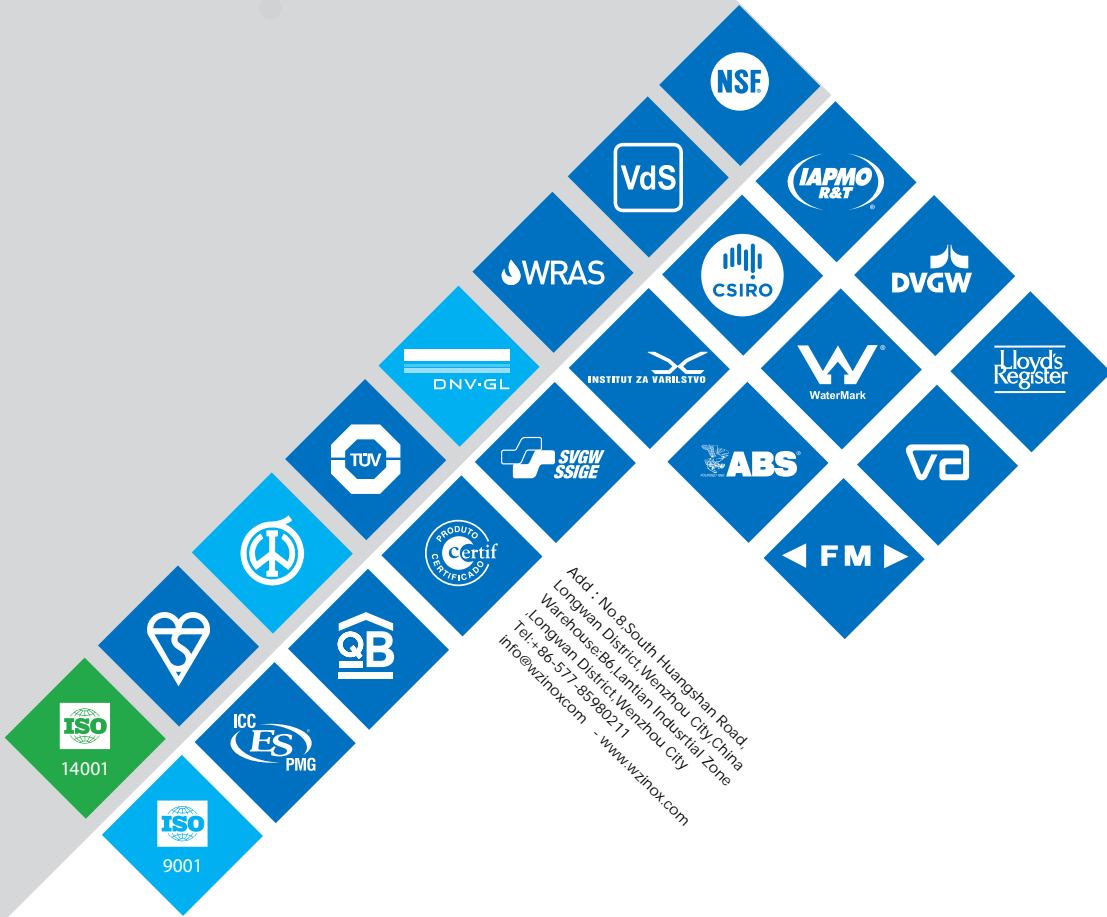
MULTIPLE AND SUBMULTIPLE UNITS

Unit Prefix	Symbol	Magnitude
micro	μ	0.000 001 [10 ⁻⁶]
milli	m	0.001 [10 ⁻³]
centi	c	0.01 [10 ⁻²]
deci	d	0.1 [10 ⁻¹]
deka	da	10 [10 ¹]
hecto	h	100 [10 ²]
kilo	k	1000 [10 ³]
mega	M	1 000 000 [10 ⁶]
giga	G	1 000 000 000 [10 ⁹]
tera	T	1 000 000 000 000 [10 ¹²]

Special Metals Welding Products Company manufactures companion welding products for the full range of its wrought alloys. The covered electrodes and bare filler wires are designed to match the high level of performance delivered by the alloys and to ensure single-source reliability in welded fabrications. The line of welding products also includes high-quality consumables for welding cast irons and for joining dissimilar metals.

COATED ELECTRODES	MAJOR USES	AWS CLASS	MIL-E-22200 TYPE
Nickel Welding Electrode 141	Nickel 200 and Nickel 201; the clad side of nickel-clad steel; joining steels to nickel alloys.	ENi-1	4N11
MONEL Welding Electrode 190	MONEL alloy 400 to itself, to low-alloy and carbon steels, to copper and copper-nickel alloys; surfacing of steels.	ENiCu-7	9N10
MONEL Welding Electrode 187	MONEL alloy 450, weldable grades of cast and wrought 70/30, 80/20, and 90/10 copper-nickel alloys.	ECuNi	CuNi
INCONEL Welding Electrode 182	INCONEL alloys 600 and 601; surfacing of steel; dissimilar combinations of steels and nickel alloys.	ENiCrFe-3	8N12
INCONEL Welding Electrode 112	INCONEL alloys 625 and 601; pit-resistant alloys; dissimilar combinations of steels and nickel alloys; surfacing of steels.	ENiCrMo-3	1N12
INCONEL Welding Electrode 117	INCONEL alloy 617; INCOLOY alloy 800HT; dissimilar combinations of high-temperature alloys.	ENiCrCoMo-1	—
INCO-WELD Welding Electrode C-276	INCONEL alloy C-276; other pit-resistant alloys; surfacing of steels.	ENiCrMo-4	—
INCO-WELD A Electrode	INCOLOY alloys 800 and 800HT; dissimilar combinations of steels and nickel alloys; 9% nickel steel; surfacing of steels.	ENiCrFe-2	—
NI-ROD Welding Electrode	Cast irons, especially for thin sections and machinability.	ENi-CI	—
NI-ROD 55 Welding Electrode	Cast irons, especially thick sections and high-phosphorus irons.	ENiFe-CI	—
NI-ROD 55X Welding Electrode	Cast irons, especially for out-of-position welding and high-phosphorus irons.	—	—
NI-ROD 99X Welding Electrode	Cast irons, especially for out-of-position welding, thin sections, and machinability.	—	—
INCONEL Welding Electrode 152	30% Cr for SMAW of INCONEL alloy 690 and other 30% Cr alloys; specifically designed for nuclear applications.	ENiCrFe-7	—
INCONEL Welding Electrode 122	For SMAW of alloys 622, C-22 and other NiCrMo alloys; excellent pitting and crevice corrosion resistance & resistance to mixed acids. Also for low NOx boiler tube overlay.	ENiCrMo-10	—
INCO-WELD 686CPT Welding Electrode	Maximum resistance to pitting, crevice corrosion & mixed acids; excellent for overlay, welding of clad steels and providing overmatching corrosion-resistant welds for all types of NiCrMo alloys and super duplex stainless steels.	ENiCrMo-14	—
FILLER METALS	MAJOR USES	AWS CLASS	MIL-E-21562 TYPE
Nickel Filler Metal 61	Nickel 200 and Nickel 201; dissimilar combinations of nickel alloys and steels; surfacing of steels.	ERNi-1	RN61 EN61
MONEL Filler Metal 60	MONEL alloys 400, R-405, and K-500; surfacing of steel.	ERNiCu-7	RN60 EN61
MONEL Filler Metal 67	MONEL alloy 450; weldable grades of 70/30, 80/20 and 90/10 copper-nickel alloys.	ERCuNi	RN67 EN67
INCONEL Filler Metal 82	INCONEL alloys 600 and 601; INCOLOY alloys 800 and 800HT; INCO alloy 330; dissimilar combinations of steels and nickel alloys; surfacing of steels.	ERNiCr-3	RN82 EN82
INCONEL Filler Metal 92	Dissimilar combinations of steels and nickel alloys.	ERNiCrFe-6	RN6A EN6A
INCONEL Filler Metal 601	INCONEL alloy 601.	ERNiCrFe-11	—
INCONEL Filler Metal 617	INCONEL alloy 617; INCOLOY alloy 800HT; dissimilar combinations of high-temperature alloys.	ERNiCrCoMo-1	—
INCONEL Filler Metal 625	INCONEL alloys 625 and 601; pit-resistant alloys; dissimilar combinations of steels and nickel alloys; surfacing of steels.	ERNiCrMo-3	RN625 EN625
INCONEL Filler Metal 718	INCONEL alloys 718 and X-750.	ERNiFeCr-2	—
INCO-WELD Filler Metal C-276	INCONEL alloy C-276; other pit-resistant alloys; surfacing of steels.	ERNiCrMo-4	—
INCO-WELD Filler Metal HX	INCONEL alloy HX.	ERNiCrMo-2	—
NC 80/20 Filler Metal	BRIGHTRAY electrical-resistant alloys; INCOLOY alloy DS.	—	—
NI-ROD Filler Metal 44	Cast irons, especially robotic and automatic welding.	ERNiFeMn-CI	—
INCONEL Filler Metal 52	30% Cr for GMAW & GTAW welding of 690 and for overlays on steel; specifically designed for	ERNiCrFe-7	—

FILLER METALS	MAJOR USES	AWS CLASS	MIL-E-00000 TYPE
INCONEL Filler Metal 622	For GMAW, GTAW, and SAW of alloys 622, C-22 and other NiCrMo alloys; excellent pitting and crevice corrosion-resistance and resistance to mixed acids; also for low NOx boiler tube overlay.	ERNiCrMo-10	—
INCO-WELD 725NDUR Filler Metal	Age hardenable 625 version; capable of heat treated ultimate tensile of 180 KSI and Rc 34 hardness.	ERNiCrMo-15	—
INCONEL Filler Metal 625BC	Designed for hot and cold wire GTAW applications for valve body overlay and internal bore cladding operations.	ERNiCrMo-3	—
NI-ROD Filler Metal 99	For GMAW, GTAW & SAW of all types of cast irons; best machinability in first layer or two layer overlays; not recommended for more than two layers.		
NIL0 CF36 Filler Metal	For GMAW, GTAW & SAW of INVAR and similar low expansion alloys; deposits crack-free welds that are closely matching in CTE to INVAR.		
NIL0 CF42 Filler Metal	Similar to NIL0 CF36, but is intended for 42% nickel low-expansion alloys.		
NI-ROD 44HT Filler Metal	For GMAW & GTAW of high temperature ductile irons to each other and to stainless steels.		
NI-ROD FC44 Cored Wire	For FCAW of all types of cast iron with 75A-25 CO ₂ ; especially suited to ductile iron welding for maximum strength and ductility of welds.		
INCO-CORED 82DH Cored Wire	For flat position [1G] FCAW welding of INCONEL 600 and similar alloys and dissimilar combinations.		
INCO-CORED 82AP Cored Wire	For all position FCAW welding of INCONEL 600 and similar alloys; also for dissimilar joints involving stainless steels, CrMo steels and carbon steels.		
INCO-CORED 625DH Cored Wire	For flat position [1G] FCAW welding of 625 and lower alloyed NiCrMo materials such as super austenitics, and 4% and 6% Mo containing stainless steels.		
INCO-CORED 625AP Cored Wire	For all position FCAW welding of 625 and lower alloyed NiCrMo materials such as super austenitics, and 4% and 6% Mo containing stainless steels.		
THERMAL SPRAYS	MAJOR USES		
DURANICKEL Thermal Spray 301TSW	For highest bond strength arc-spray build ups and bond coats; for bonding and protective coatings.		
INCONEL Thermal Spray 625TSW	Corrosion-resistant arc-spray coatings used for pulp and paper and other industry applications.		
INCONEL Thermal Spray 72TSW	Most sulfidation-resistant arc-spray product; used extensively in black liquor recovery boilers.		
INCOFLUX	MAJOR USES		
INCOFLUX 5	For SAW butt welding with MONEL FM 60 and butt welding and overlaying of cast iron with NI-ROD FC 55.		
INCOFLUX 6	For SAW with FM 82, 625, 61, CF36, CF42, NI-ROD FM 99 and 44; for limited thickness butt welds and overlays.		
INCOFLUX NT100	Neutral SAW flux for overlays with FM 82, 625, 61 and NI-ROD FM 44 and 99; also used with FM CF36 and CF42.		
INCOFLUX NT110	Neutral SAW flux for overlaying with MONEL FM 60 and 67.		
INCOFLUX NT120	SAW flux for butt welding and overlaying with FMs C-276, 622, and 686CPT.		
INCOFLUX ESS1	High-deposition rate flux for strip overlays with INCONEL weldstrips 82, 625, and INCO-WELD weldstrip 686CPT with ESS processes.		
INCOFLUX ESS2	For electroslag strip welding overlay [ESSW] with INCONEL 52 and 52M Weldstrips.		
INCOFLUX ESS3	For electroslag strip welding overlay [ESSW] with INCONEL 82, 622 and 625 Weldstrips, and INCO-WELD C-276.		
INCOFLUX ESS4	For electroslag strip welding overlay [ESSW] with INCONEL 625 Weldstrips, and INCO-WELD C-276 and 86CPT.		
INCOFLUX SAS1	High deposition rate flux for strip overlays with INCONEL weldstrips 82 and 625.		
INCOFLUX SAS2	For submerged arc strip welding overlay [SASW] with INCONEL 52 and 52M Weldstrips.		
WELDSTRIP	MAJOR USES		
MONEL Weldstrip 60	Weldstrip for producing MONEL 400 type overlays at high-deposition rates with the electroslag surfacing [ESS] and submerged arc strip [SAS] processes.		
Nickel Weldstrip 61	Weldstrip for producing nickel overlays at high-deposition rates with ESS and SAS processes.		
INCONEL Weldstrip 82	Weldstrip for high-deposition rate overlays of 20% Cr INCONEL alloy using ESS and SAS processes.		
INCONEL Weldstrip 625	Weldstrip for high-deposition rate overlays of INCONEL alloy 625 type using ESS and SAS processes.		



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