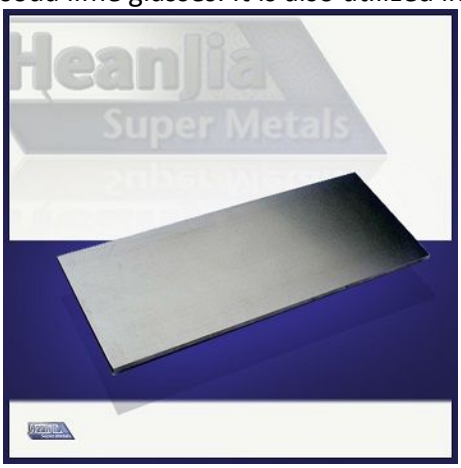
Nilo 48 Alloy

Heanjia Super Metals Co., Ltd

Heanjia Super Metals Co., Ltd manufactures broad range of Nickel - Iron or Nilo alloys for the industrial operations that need controlled expansion at high temperatures and magnetic properties.

Nilo 48 Alloy

Nickel-Iron 48 alloy consists of 48% Nickel. The primary use of alloy is in the glass to metal seals in soft lead or soda lime glasses. It is also utilized in thermostat operations in the commercial operations up to 450oC.



Chemical composition of Nilo alloys:

Alloy	Ni	Fe	Others
NILO alloy 36	36	64	-
NILO alloy 42	42	58	-
NILO alloy 48	48	52	Nb 3.3,Ti 1.4, C 0.02
Nilo K	29.5	53	Co 17.0
NiloMag 77	77	13.5	Cu 5.0, Mo 4.2

The physical properties of Nilo alloys used for airspace applications are shown below:

Material	Density		Thermal conductivity		Specific heat capacity		Energy needed to heat 1m3 tool to 180°C	
	lb/in3	g/cm3	Btuin/ft2 hoF	W/moC	Btu/lb °F	J/kg °C	kW h	MJ
NILO 36	0.293	8.11	73	10.5	0.12	500	186	670
NILO 42	0.293	8.11	73	10.5	0.11	460	168	605
NILO 365	0.293	8.11	86	12.4	0.12	500	180	648
Graphite Epoxy	0.058	1.6	24	3.5	0.18	750	54.2	195
Monolithic Graphite	0.060	1.67	-	-	0.31	1300	95.9	345
Electroformed Nickel	0.311	8.65	761	110	0.11	460	176	635
Aluminum	0.098	2.73	1127	163	0.22	920	111	400

Melting and Inflection Points of Nilo Alloys

Alloy	Melting Point	Inflection Point

NILO alloy 36	1430	2605	220	430
NILO alloy 42	1435	2615	370	700
NILO alloy 48	1450	2640	460	860
NILO alloy 52	1450oC	2640	450	840
NILO alloy K	1450oC	2640	450	840

Thermal conductivity at 20oC

Alloy	W/m°C	Btu in/ft²h °F
NILO alloy 36	10	69.3
NILO alloy 42	10.5	72.8
NILO alloy 48	16.7	11.6
NILO alloy K	16.7	11.6

Electrical resistivity

Temperature		Microhm cm			
oC	oF	NILO alloy 36	NILO alloy 42	NILO alloy 48	NILO alloy K
20	68	80	61	47	43
100	212	86	70	54	55
200	392	97	87	71	72
300	572	105	101	89	88

The mechanical properties of **Nilo 48 alloy** are provided below:

Temperature		Tensile strength		Yield Strength		Elongation on 50 mm (2 inch) %	Reduction of Area %
oC	oF	MPa	Ksi	MPa	Ksi		
20	68	520	75.0	260	38.0	43	72
100	212	480	70.0	210	30.0	43	72
200	392	470	68.0	160	23.0	43	72
300	572	460	67.0	150	22.0	43	72
400	752	400	58.0	130	19.0	47	70

Effect of Temperature

The temperature plays wide role in altering the magnetic properties of **Nilo alloy** such as the coercive force and residual induction regularly decrease with an increase in temperature without variation in the phase.

It might be noted that hysteresis loop for alloy decreases with rise in temperature. Moreover the fabrication influences the magnetic features.

These are shown in the below table:

Heat Processing	**Initial Permeability**
1 hr. 800°C. 60°C/hr. Furnace cool to Room Temp	800
1 hr. 900°C. 60°C/hr. Furnace cool to Room Temp.	900

1 hr. 1000°C. 60°C/hr. Furnace cool to Room Temp	800
1 hr. 1100°C. 60°C/hr. Furnace cool to Room Temp.	800
4 hr. 1100°C. 60°C/hr. Furnace cool to Room Temp.	500
1 hr. 1200°C. 60°C/hr. Furnace cool to Room Temp.	500

Fabrication of Nilo Alloy

The **Nilo 36 alloy** and 42, 48 and other alloys can be heat and cold processed, machined and produced by the process as followed for the austenitic stainless steel. The Nilo alloys can be welded by employing Nickel Welding Electrode 141, INCO-WELD A, or INCOWELD B electrodes by following the metal arc method and Nickel Filler Metal 61 or INCONEL Filler Metal 82 for TIG, plasma, MIG, or pulsed arc welding. The MIG spray and submerged arc welding methods are not preferred for Nilo alloys. The welding of **Nilo 36** and **Nilo 42** is performed for the aerospace components.The **Nickel-Iron alloy wire** is offered in the annealed temper. The cutting, forming, welding and rough machining is performed on the annealed material subsequently age hardening and eventual machining. In the aging cycle, a nominal contraction takes place in Nilo alloy just like the other age hardening nickel alloys. The fabricated tool moving while heat processing is reduced and causes no issues while tool production or use.

The **Nickel-Iron alloy** can be immediately cold processed in the annealed condition and machined easily like annealed or annealed and age hardened temper. The large strength and toughness, age hardening Nilo alloy 365 is nominally sticky while machining than the tender, annealed **Nilo alloy 48**.

Welding

Using **Nilo alloy** for composite tooling at onetime is restricted by less welding components that cause sound weld metals more incline to cracking which are however overcome by Nilo filler metals CF36 and CF42, filler wires with expansion rates similar to the main metals providing excellent crack free, vacuum rigid welds by submerged arc, gas metal arc and gas tungsten arc processes.

The improved composition of niobium and carbon produced for **Nickel-Iron alloy** welding proves to be better over previous manganese and titanium improved composition also called as Invar that is crack sensitive and possesses three times CTE of Nilo filler CF36. Choosing the approximate filler metal that should be produced to meet the thermal expansion nature needed for the weld. The expert engineers at Heanjia alloys are continuously attempting on the production of new welds for Nilo alloys. The produced quality is superior. 100% inert shielding gas is preferred. The care is taken to monitor the highest interpass temperature limit to 300oF or 150oC to prevent oxidation and undercutting.

The Gas metal arc welding GMAW parameters are shown in the below table:

Transfer Type	Wire Feed Speed		Voltage	Current
	in/min	m/min	Vol	Amp
Spray	300 - 400	7.6 - 10.2	29 – 33	
Short Circuit	500	12.7	25 – 27	
60 Pulses/Second	250	6.3	21 (background)	400 peak/150 average

120 Pulses/Second	320	8.1	21 (background)	400 peak/170 average

The weld beads on the pickled or unready plate causes the GMA cleaning task undercutting any oxide layer is produced. It is resolved by removing the oxide layer prior to welding. If the preparation is not viable, the SAW process is considered as the flux utilized with SAW permits welding without inner cutting. In case SAW is not viable, GMAW attachment value weldments can be prepared, free of undercutting by using the short circuiting factors are listed in the above table.

The plunged **Nickel-iron alloy** filler metals CF36 and CF42 provide wonderful SAW features. Use of INCOFLUX 6 is highly preferred to get the excellent results. SAW can be done by following the traditional factors as provided in the below table:

	Wire Feed Speed		Voltage	Current	Travel Speed	
	in/min	m/min	Vol	Amp	in/min	mm/min
Typical	370	9.4	31-34	230-260	8-12	203-305
High Deposition	650	16.5	32	320-360	8-15	203-381

The traditional processes provide the accumulation rate of about 10 lb (4.5 kg) per hour) and superior quality welding parts that are produced at the speed of 18 lb or 8.1 kg per hour.

Applications of Nilo 48 Alloy

1. Transformer, inductor, magnetic shield, switches
2. Tape recorder head and memory storage.

Nickel-Iron alloy Product Forms Available:

Wire, Strip, Sheet, Plate, Ribbon, Tape