Electroformed Nickel Foil

The nickel foil made at Special Metals, Hereford, UK, is made by a continuous electrodeposition process, producing a foil of consistent quality in greater widths and lower thicknesses than are available by conventional metal rolling, both in the hard ("as-electroformed") and annealed conditions.

Electroformed nickel foil has very high chemical purity, excellent and consistent surface finish, and good etching characteristics. Its applications include battery mesh, heating elements, bursting discs, gaskets, lead frames and printed resistor/circuit boards. Other applications have utilized the inherent magnetic properties of nickel.

Composition and physical and mechanical properties are outlined in Tables 1, 2 and 3. For comparison of mechanical properties, the tensile strength of wrought, annealed nickel is about 450 MPa (65 ksi), and the elongation is around 40%. Hard-rolled nickel strip has a tensile strength of 620-790 MPa (90-115 ksi), and an elongation of 15-10%.

Table 1—Typical Composition, %

Nickel	99.95 min.
Carbon	0.01 max.
Chromium	0.01 max.
Cobalt	0.01 max.
Copper	0.01 max.
Iron	0.03 max.
Sulfur	0.002 max.
Zinc	0.001 max.

Table 2— Physical Properties

Density, g/cm^3	8.9
lb/in^3	0.322
Electrical Resistivity	
At 20°C, μΩ•cm	8
At 68°F, ohm•circ mil/ft	48

Table 3—Mechanical Properties

As Electroformed				
Foil Thickness, micron (inch)	10 (0.0004)	20 (0.0008)	50 (0.002)	100 (0.004)
Tensile Strength, MPa (ksi)	780 (113)	730 (106)	650 (94)	570 (83)
Elongation on 50 mm, %	0.5	1	6	9
Hardness, HV (200 g load)	-	-	195	205
Annealed				
Foil Thickness, micron (inch)	13 (0.0005)	25 (0.001)	50 (0.002)	100 (0.004)
Tensile Strength, MPa (ksi)				
Longitudinal	300 (43.5)	290 (42)	360 (52)	390 (57)
Transverse	290 (42)	290 (42)	350 (51)	360 (52)
Elongation, %				
Longitudinal	6	9	>18	28
Transverse	6	8	14	16
Hardness, HV (200 g load)	60	59	77	95

Corrosion Resistance

Electroformed nickel foil shows the same excellent corrosion resistance as wrought nickel in many environments. Like the wrought product, it tends to tarnish in industrial and marine atmospheres but it can be coated with conventional or microcracked chromium to reduce this tendency.

Joining

Special Metals electroformed nickel foil can be soldered and welded by the same techniques used for joining conventionally produced nickel foil.

Information on joining is available in the Special Metals publication "Joining" on the website, www.specialmetals.com.

Surface Finish

Electroforming produces one satin polished surface, the other with a smooth matt appearance. Surface roughness of the matt side depends on the thickness; typically 0.4 micron (0.0002 in) center line average for 20 micron (0.0008 in) foil.

Cold Forming

Thicker gauges show good forming characteristics without annealing, but the foil can be most readily formed if it is fully annealed. The results in Table 4 were obtained on 100 micron (004 in) foil using a polythene lubricant.

Table 4—Forming Characteristics

Condition	Erichsen cup height		Maximum load	
	Mm	In	N	lbf
As electroformed	3.0	0.12	830	187
Electroformed and annealed	4.4	0.17	820	185
Conventional rolled and annealed foil	4.3	0.17	1150	259

Availability

Thickness 8-100 microns (0.00031-0.004 in)

Width Up to 500 mm (19.5 in)

Weight (in rolls) Up to 50 kg (110 lb); e.g. approximately 1400 m at 8 microns and approximately 112 m at 100 microns.

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