

# Electroforming Design Guidelines

<b>Modulus of Elasticity (Young's Modulus)</b>	Average NiCo Sample: 25.260 million pounds per square inch (mp/in <sup>2</sup> ) NOTE: Compare NiCo to: A5 Stainless Steel: 35 mp/in <sup>2</sup> ; Aluminum: 10 mp/in <sup>2</sup> ; CarbonSteel: 30.0 mp/in <sup>2</sup>
<b>Coefficient of Thermal Expansion (CTE)</b>	11.5 to 14.7 x 10 <sup>-6</sup> cm/cm/°C (from 0 °C to 1000 °C) [Commercially electroplated nickel= 13.37 x 10 <sup>-6</sup> cm/cm/°C ]
<b>Hardness</b>	Knoop: 576+; Vickers: 560; Rockwell C: 51-53
<b>Flexural Strength</b>	250,000 pounds/in <sup>2</sup>
<b>Tensile Strength</b>	250,000 pounds/in <sup>2</sup>
<b>Primary Chemical Composition (Typical)</b>	Nickel: 86% Cobalt: 14% Sulfur: 0.05%
<b>Suitability of Our Electroforming Technology</b>	High Precision Applications with irregularly shaped two-or three- dimensional durable metal parts. Micron-Level Mechanical Features and Sizes which are difficult or impossible to make using conventional metal fabrication techniques; e.g., photochemical milling, EDM, etc. Extremely smooth, flat, and fine-grained metal parts that need to be made with tight tolerances and high repeatability.
<b>Small Lot Array Size Range</b>	114.3 x 114.3mm (4.5" x 4.5")
<b>Production Lot Array Size</b>	254.0 x 254.0mm (10.0" x 10.0")
<b>Foil Thickness Range</b>	0.005mm to 0.254mm (0.0002" to 0.0100") Thicker foils are possible, however they may require special procedures
<b>Funnel-Shaped Apertures</b>	Ideal for: Gas Handling, Fluid Control/Jetting, Light Control, Precision Standards
<b>Foil Thickness</b>	0.0125 to 0.254mm (0.0005" to 0.0100") Thinner foils are available however require special procedures
<b>Minimum Aperture Diameter</b>	0.002mm (0.00008")
<b>Minimum Aperture Spacing</b>	2 x Thickness (Foil) + 10microns
<b>Aperture Tolerance</b>	0.0015mm (0.00006") for apertures with diameters > 0.025mm (0.001") Apertures with diameters <0.025mm will generally have smaller tolerances and require special procedures depending on the foil thickness, overall sheet size and other geometries of the foil.
<b>Structure and Edge Quality</b>	Pits, bumps, and other irregularities will not exceed 0.000127mm (0.000005")
<b>Straight-Wall Parts</b>	Ideal For: Micro Embossers, Fluid Control/Jetting, Fiber Optic Clips
<b>Foil Thickness</b>	0.0125 to 0.152mm (0.0005" to .0060") Thicker and thinner foils are available, but will require special procedures.
<b>Minimum Aperture Diameter</b>	1 x Thickness (Foil). Smaller diameters may be available, but will require special procedures.

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<b>Minimum Aperture Spacing</b>	1 x Thickness (Foil). Closer spacing may be available, but will require special procedures.
<b>Aperture Tolerance</b>	0.0025mm (0.0001") per 0.025mm (0.001") of foil thickness for apertures with diameters of > 0.025mm (0.001"). Apertures <0.025mm (0.001") will generally have smaller tolerances and require special procedures regarding foil thickness, overall sheet size and other geometries of the foil
<b>Structure and Edge Quality</b>	Pits, bumps and other irregularities will not exceed 0.000254mm (0.000010")
<b>Multi-Level Structure</b>	Limits and tolerances are similar to those outlined in "Straight-Walled Apertures" above. Tolerances may vary due to the specific construction requirements and therefore the entire multi-level assembly must be considered as a whole from the standpoint of tolerances.
<b>Air Bridges</b>	Technology is available to manufacture these structures