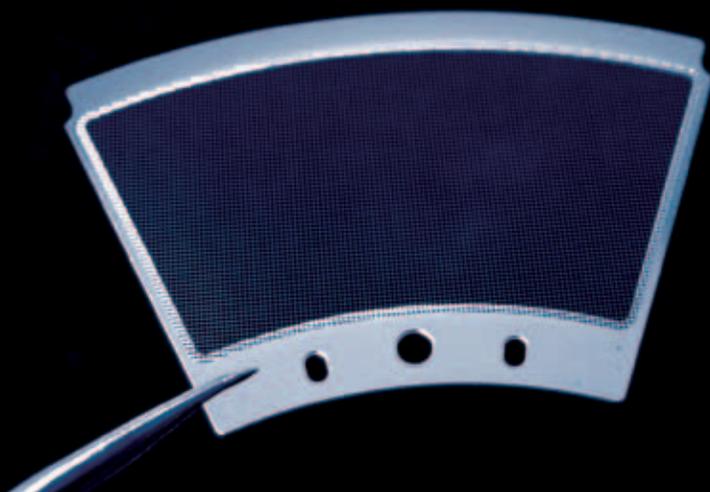
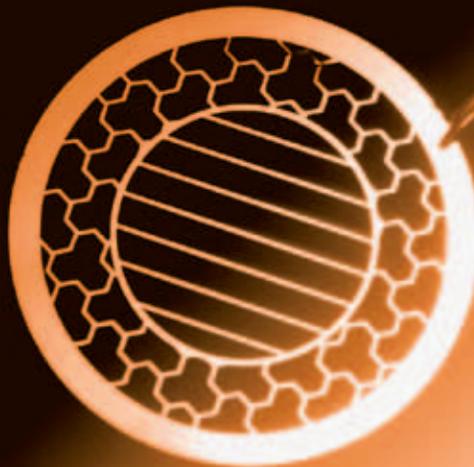


THIN METAL PARTS

ISO 9001:2008 & ITAR Registered



CHEMICAL ETCHING

ELECTROFORMING

LASER CUTTING

PRINTED GLASS & FILM

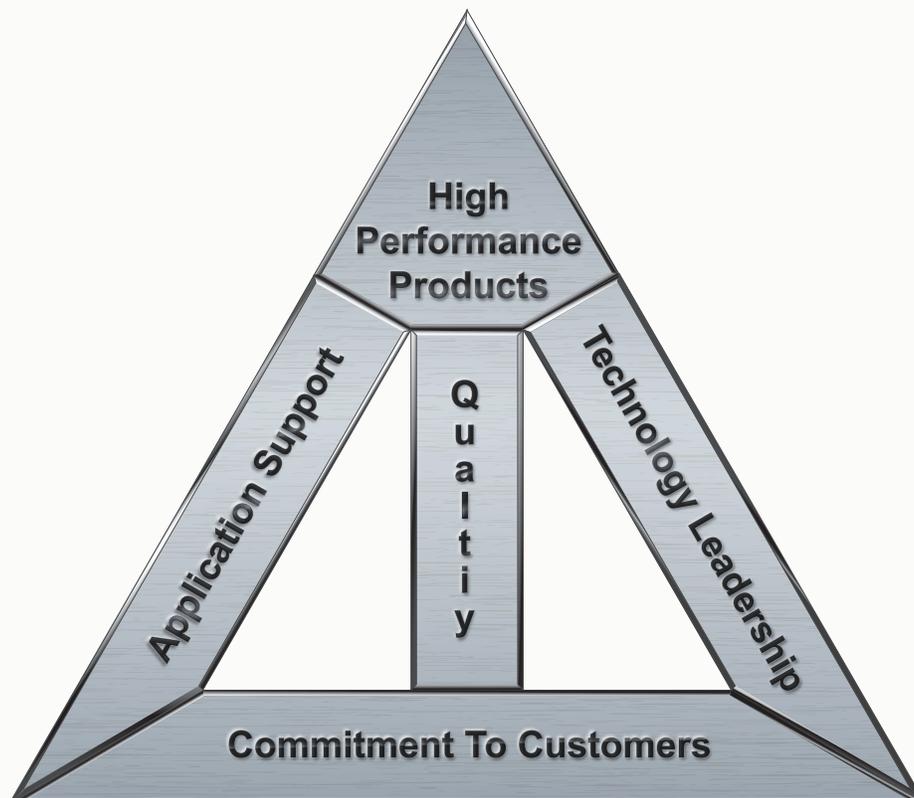
SMT STENCILS

Our Philosophy

Thin Metal Parts (TMP) has clear industry leadership in the following areas:

- The most complete line of **HIGH PERFORMANCE** thin metal parts: Electroformed, Laser-Cut and Chem-Milled
- Continued **TECHNOLOGY LEADERSHIP** in the industry...with significant and on-going R&D
- An **ISO 9001:2008 QUALITY** certified company with complete process controls and analytical laboratory.
- Highly-trained and dedicated people to provide true **APPLICATIONS SUPPORT**
- A culture of **COMMITMENT TO CUSTOMERS** with continued investment in people, facilities, equipment and systems to support our commitment to be **THE INDUSTRY'S BEST VALUE.**

We encourage you to closely compare TMP's products and services to any other supplier. We are confident that TMP delivers the **BEST TRUE VALUE.**



History of Thin Metal Parts

- 1985** Specialty Parts, a product line of Photo Stencil, was started to address the precision parts needs of the Photo Stencil circuit board manufacturing customers using photo-chemical milling process.
- 1990** Parts began to be manufactured using the laser cutting process.
- 1997** Became the first parts manufacturer to become ISO 9001 certified (now ISO 9001:2008).
- 1999** Began using the electroforming process to manufacture precision metal parts.
- 2002** Introduced multi-layer and 3D electroforming
- 2002** The Specialty Products Division became the **Thin Metal Parts Company** to better focus efforts on thin metal parts development.
- 2004** Significant efforts began to target new industries in addition to electronics.
- 2007** Thin Metal Parts acquired industry leading photo-plotting equipment, increasing quality and capability.
- 2009** Achieved ITAR registration - certificate M25093

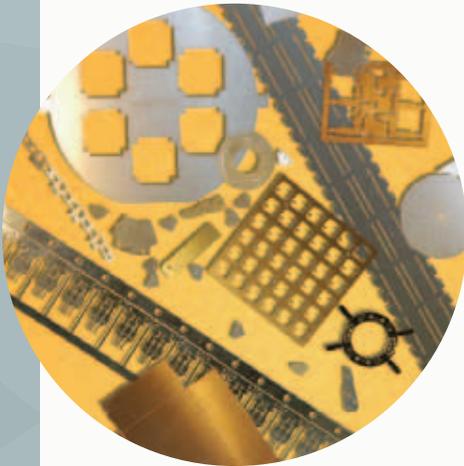
Throughout the history of Thin Metal Parts, the company's philosophy of "solution partnering" with customers has resulted in myriad innovations and products. A sampling of products developed as DOE projects:

- Precision Encoder Wheels
- 1250 LPI mesh for medical / analytical applications
- Innovative tooling rings for applications in extrusion plastics industry
- Glass products produced with 65,000 dpi mylar masters
- New mandrel rehab process for ultra-smooth applications



Complete Source

Thin Metal Parts offers full in-house design, tooling, and manufacturing. With several manufacturing methods available, our staff is able to offer expert guidance and match the most appropriate method with each application.

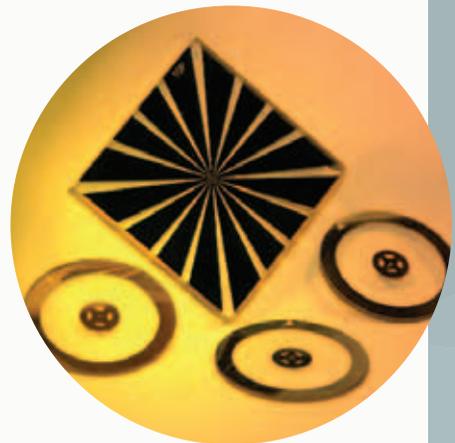


Custom Metal Parts

Electroformed
Chemically-Milled
Laser-Cut

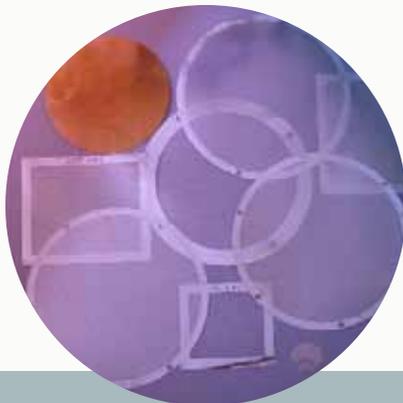
Imaged Glass and Film

High reflectivity chrome
Low reflectivity chrome
Iron-Oxide
Aluminum-Oxide
Emulsion



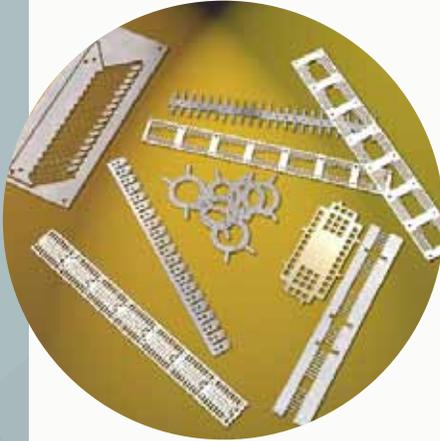
Mesh

Electroformed
Chemically-Milled
Laser-Cut



Analytical Sieves

Electroformed

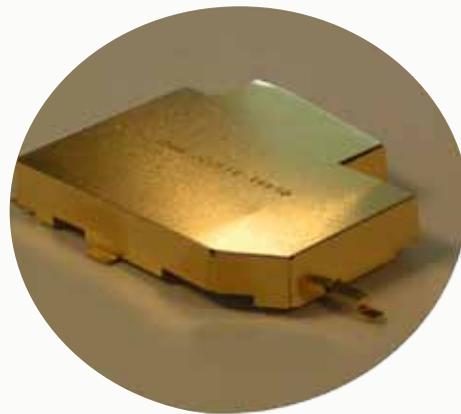


Lead Frames

Electroformed
Chemically-Milled

RFI/EMI Shields

Chemically-Etched
Electroformed
Chemically-Milled

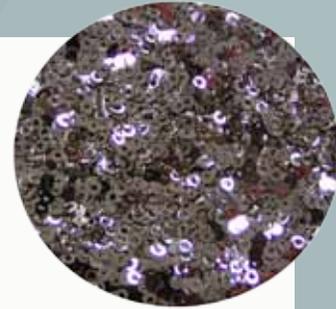


Encoder Wheels

Electroformed
Laser-Cut
Chemically-Milled
Glass
Mylar®

Chemical Etching

Thin Metal Parts' chemical etching is an excellent choice for a wide range of designs and applications, offering tight tolerances, a long list of available materials & thicknesses, quick lead times, and competitive pricing. Through continuous innovation, TMP has elevated this tried-and-true process to new levels of capability.



TMP Advantages

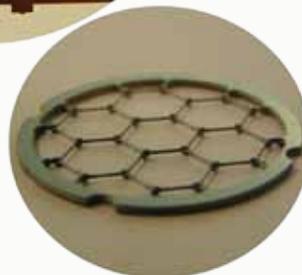
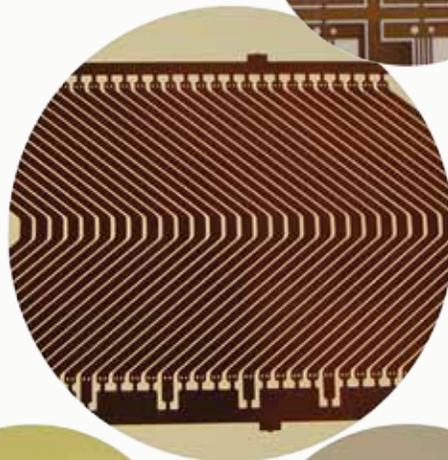
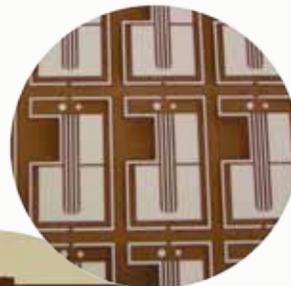
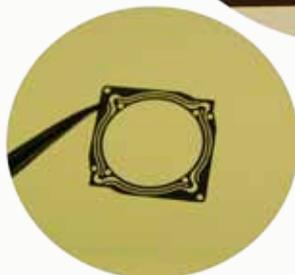
- Exclusively Vertical Chemical Milling
- Tooling complete in hours
- Tab-free designs available
- Clean-room photolithographic area
- Exclusively collimated light exposure systems
- May be combined with electroforming and laser cutting to produce highly complicated designs
- Secondary Forming Available

Thickness

From 0.0003" to 0.060"

Available Finishes

Nickel
Chrome
Tin
Zinc
Titanium Nitride
Gold
Silver
Black Oxide
Black Chrome
...and more

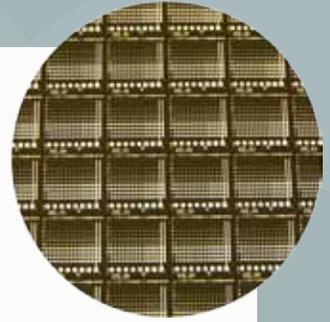


In-stock Metals

Alloy 42
Aluminum
1100
1145
2024
5052
Beryllium Copper
C172
C190
Brass
C260
C273
Cold Rolled Steel
1008
1010
1018
1075
Copper
C110
C101
C102
C194
Nickel
200
201
Nickel Silver
Phosphorus Bronze
Spring Steel
440
716
Stainless Steel
17-7
301
302
304
316
420
430

Electroforming

The ultimate in precision and tolerance, Thin Metal Parts' electroforming process offers feature sizes as small as 15 microns. Exclusively utilizing pure nickel, the process combines photolithography and electroplating to build products that are tab and burr free.



TMP Advantages

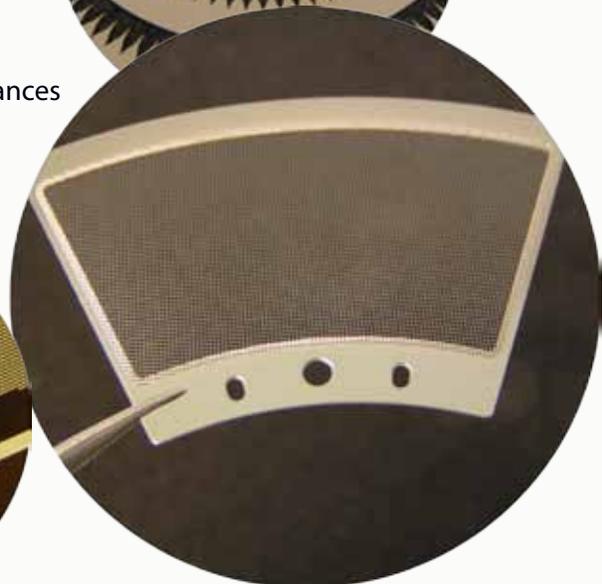
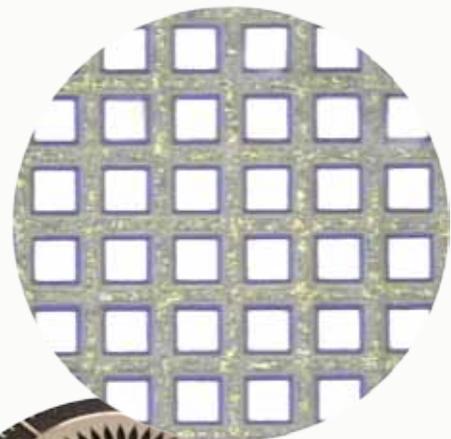
- Proprietary substrate preparation process results in mirror-like finish both front and back
- No visible grain direction
- Products are tab-free
- Clean-room photolithographic area
- Exclusively collimated light exposure systems
- Tooling complete in hours
- Most products can be shipped within 1-3 days

Thickness

From 0.0002" to 0.010"

Tolerances

Generally up to +/- 0.0003", although tolerances vary by application.



Laser Cutting

Thin Metal Parts employs state-of-the-art laser equipment to achieve an outstanding combination of edge quality, tolerances, and feature sizes in a wide variety of metals. Specially designed for use with very thin metals, our lasers are able to create openings as small as 11 microns.

TMP Advantages

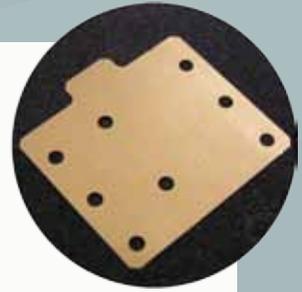
- Laser Beam diameter 22 microns (0.00087")
- Excellent performance on metals not ideally suited for etching, such as titanium and tungsten
- In-house engineering
- Tab-free designs available
- May be combined with electroforming and chemical etching to produce highly complicated designs
- Secondary Forming Available

Thickness

From 0.0005" to 0.025"

Available Finishes

Nickel
Chrome
Tin
Zinc
Titanium Nitride
Gold
Silver
Black Oxide
Black Chrome
...and more

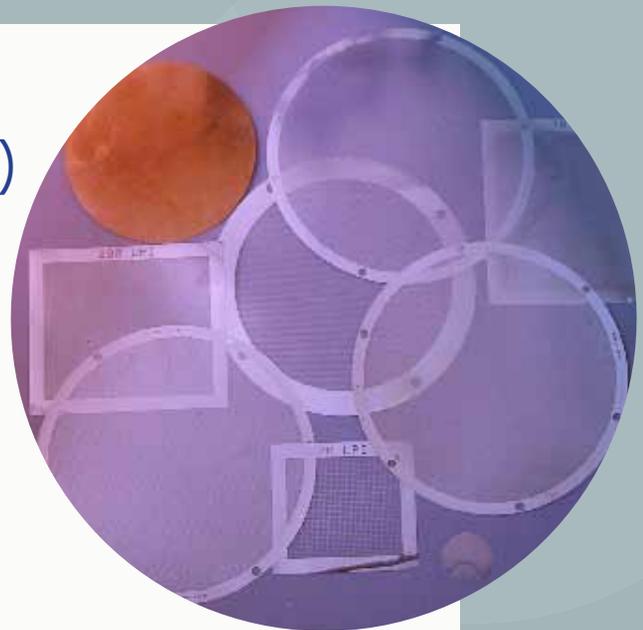


In-stock Materials for laser cutting

Alloy 42
Cold Rolled Steel
1008
1010
1018
1075
Inconel
Kapton
Kovar
Molybdenum
Nickel
200
201
Nickel Silver
Nitinol
Phosphorus Bronze
Silicon Steel
Spring Steel
440
716
Stainless Steel
17-4
17-7
301
302
304
316
420
430
Titanium
Tungsten

Electroformed Mesh (e-fab)

Thin Metal Parts (TMP) offers high-precision E-Fab Mesh, manufactured with the proprietary electroforming process. E-Fab Mesh achieves the highest standards for optical light transmission (OLT), as well as for gas and liquid filtration applications.



Advantages

Thickness: E-Fab Mesh is available in a wide range of thicknesses to suit the design requirements of each specific application. When strength is a concern, this process allows TMP to produce a product at greater thicknesses than woven wire or even other Electroforming techniques. Alternatively, E-Fab Mesh can be produced at very fine thicknesses down to 10 microns.

Non-Woven: Unlike woven wire mesh, E-Fab Mesh is a single, flat piece of metal. By eliminating the criss-cross wires, E-Fab Mesh will not trap particles...making cleaning more efficient. Additionally, light transmission can be maintained within a $\pm 2\%$ transmission tolerance.

Corrosion Resistance: Produced from 100% pure nickel with no plating to wear off, Electroformed Mesh has natural corrosion resistance that will not diminish with time.

Custom High-Temperature Option: Through a custom-developed process, E-Fab Mesh can withstand temperatures exceeding 500°C for decontamination and tensioning requirements.

Custom Manufacturing: E-Fab Mesh by TMP is highly customizable by variations in wire width, hole size, thickness, hole shape and overall shape. A nearly limitless number of product configurations are available. Furthermore, TMP's cutting edge photolithography manufacturing techniques allow customizing to occur without long delays or high prices.

Most Common Mesh Sizes

Wires per Inch	Hole Size (inches)	Wire Width (inches)	Maximum Transmission (Open Area)
750	0.00099	0.00034	55.0%
400	0.00194	0.00056	60.0%
300	0.00206	0.00073	61.0%
250	0.00325	0.00075	66.0%
200	0.00406	0.00094	66.0%
150	0.00570	0.00097	73.0%
110	0.00787	0.00122	75.0%
90.1	0.01055	0.00055	88.0%
70	0.01355	0.00073	90.0%

Electroformed Analytical Sieves (e-Fab)

Thin Metal Parts (TMP) offers high-precision E-Fab Analytical Sieves, manufactured with the proprietary electroforming process. E-Fab Analytical Sieves achieve the highest standards for particle sizing sieves available today.



Advantages

Tolerance: up to ± 2 microns

Non-Woven: Unlike woven wire mesh, an E-Fab Analytical Sieve is a single, flat piece of metal. By eliminating the criss-cross wires, E-Fab Analytical Sieves will not trap particles...making cleaning more efficient. Additionally, partial sizing can be maintained within a ± 2 micron specification.

Corrosion Resistance: Produced from 100% pure nickel, an E-Fab Analytical Sieve has natural corrosion resistance that will not diminish with time.

Custom High-Temperature Option: Through a custom-developed process, E-Fab Analytical Sieves can withstand temperatures exceeding 500°C for decontamination and tensioning requirements.

Most Common Analytical Sieve Sizes

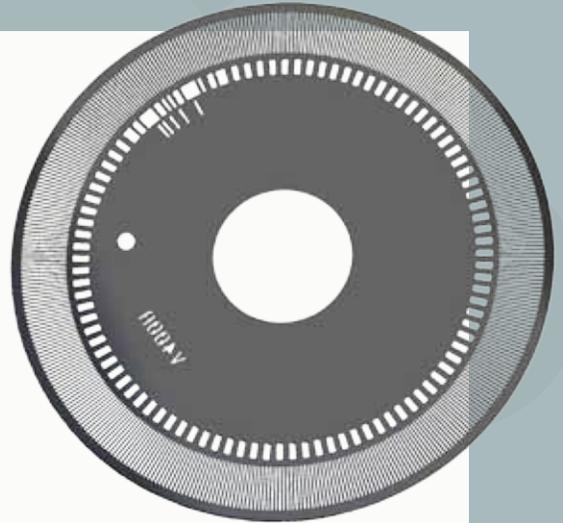
Nominal Opening Size (μm)	Tolerance on Sieve Openings (μm)	Limits, Openings per Linear Inch	
		Minimum	Maximum
106	up to 2.0	120	150
75	up to 2.0	150	200
53	up to 2.0	200	280
38	up to 2.0	250	350
32	up to 2.0	280	400
25	up to 2.0	300	500
20	up to 2.0	400	750
15	up to 2.0	400	750

Available Circular Frame Sizes

Current Nominal Diameter (in)	Inside at Top	Outside on Skirt	Nominal Height
3	3.0 in + 0.03/-0.00 (76.2 mm + 0.76/-0.00)	3.0 in + 0.00/-0.03 (76.2 mm + 0.00/-0.76)	1 in (25.4 mm)
8	8.0 in + 0.03/-0.00 (203.2 mm + 0.76/-0.00)	8.0 in + 0.00/-0.03 (203.2 mm + 0.00/-0.76)	2 in (50.8 mm)
8	8.0 in + 0.03/-0.00 (203.2 mm + 0.76/-0.00)	8.0 in + 0.00/-0.03 (203.2 mm + 0.00/-0.76)	1 in (25.4 mm)

Metal Encoder Wheels

Thin Metal Parts (TMP) introduces the Metal Encoder Wheel product line for high-precision applications in Incremental and Absolute rotary encoders. Metal Encoder Wheels can be manufactured using the Electroforming Process, which ensures the highest quality metal encoder wheel available today. In addition, the Optical Masks produced by the same electroformed process are available in any size or configuration.



Advantages

Resolution: The Electroformed Metal Encoder Wheels are available in resolutions previously unheard of in metal encoder wheel technology. Closer tolerances, greater design capability and increased consistency are all attributes of the TMP proprietary electroforming process.

Flatness: The TMP proprietary electroforming process reduces the amount of surface tension imposed on the metal encoder wheel, minimizing any possibility of warping.

Cost: In most applications, metal encoder wheels offer an inexpensive alternative to glass encoder wheels without sacrificing quality.

Dimensional Stability: Temperature and humidity have virtually no impact on the Metal Encoder Wheel. In addition, the TMP metal encoder wheels can be used in high-shock environments with dependable results.

Corrosion Resistance: Metal Encoder Wheels are 100% hard nickel, giving excellent corrosion resistance.

Multi-Layer Technology: TMP offers a multi-layer option to maximize the metal encoder wheel's stability and strength.

• Most Common Metal Encoder Wheel Sizes

Resolution Count	MAX. THICKNESS		FEATURE SIZE	
	1" Diameter	2" Diameter	1" Diameter	2" Diameter
256	0.0025	0.0025	0.00552	0.01104
512	0.0025	0.0025	0.00276	0.00552
1024	0.0008	0.0025	0.00138	0.00276
2048	N/A	0.0008	N/A	0.00138

• Other sizes available upon request from 0.25" thru 8.0" OD

Glass Encoder Wheels

Thin Metal Parts (TMP) introduces the Glass Encoder Wheel product line for high-precision applications in Incremental and Absolute rotary encoders. Glass Encoder Wheels are manufactured using the Chrome-Etch Process, which ensures the industry's highest quality encoder wheel...metal or glass.



Advantages

Resolution: The TMP Glass Encoder Wheels feature significantly higher resolutions per inch than available with metal encoder wheels. Up to 500 LPI is the standard, with greater resolutions available upon design approval. The line width standard is 0.001".

Feature Size: The standard minimum feature size is 15 microns, while smaller capabilities can be attained through custom design.

Lead Times: TMP's Chrome-Etch process allows for quick product turnaround times...generally within a 5 to 14-day period.

Dimensional Stability: Temperature and humidity have virtually no impact on the Glass Encoder Wheel. Unlike metal encoder wheels, the TMP Glass Encoder Wheel has no tension or flatness problems.

Design Flexibility: Countless shapes and sizes are available for glass encoder wheels with diameters up to 3" standard...e.g., rectangle, square, bevel, center hole. Diameters of 3" to 7" require custom design. When floating features are implemented, TMP Glass Encoder Wheel options become limitless.

Most Common Glass Encoder Wheel Sizes

	Size	Glass Thickness	Feature Size	Feature Tolerance	On-Center/ Pitch
Typical	0.5 – 7"	0.02 – 0.06"	15 μ m	± 2 μ m	± 0.5 μ m
Custom	up to 24x24"	up to 0.22"	3 μ m	± 2 μ m	± 0.5 μ m

Lead Frames

Thin Metal Parts offers a complete line of photochemically-milled and electroformed lead frames. A wide range of alloys are available to meet critical properties: high strength, formability, and high electrical and thermal conductivities.

Lead frames provide mechanical support to the die during its assembly into a finished product. It consists of a die paddle, to which the die is attached, and leads, which serve as the means for external electrical connection to the outside world. The die is connected to the leads by wires through wirebonding.

Advantages

- Patented Electroforming Process
- Vertical Chemical Milling
- Rapid Prototyping
- Low Tooling Costs
- Burr-Free Edges
- Secondary Forming Available

Thickness

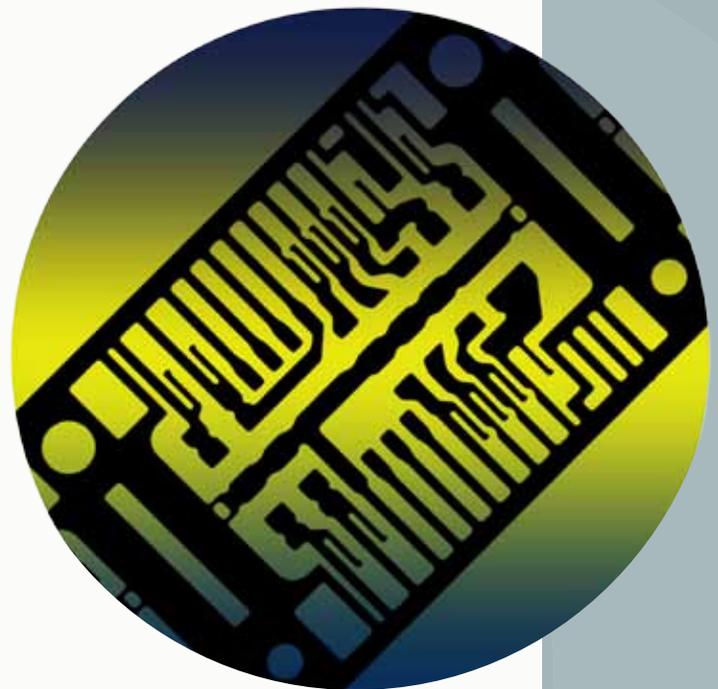
From 0.0005" to 0.060"
Dimensional Tolerance ± 0.0005

Metals Available

Nickel Alloys
Pure Nickel
Copper
Beryllium Copper
Kovar
Phosphorus Bronze
Brass

Platings Offered

Tin
Tin-lead
Silver
Nickel
Gold



RFI/EMI Shielding

The RFI/EMI Product Line offers the highest quality RFI/EMI component shielding featuring burr-free edges, easy construction, and the ability to add custom logos, part numbers, or other identification. Thin Metal Parts specializes in quick-turn, prototype, and low-to-medium volume production runs. Manufacturing options include Chemical-Milling, Laser-Cutting, and Electroforming as well as metal stamping for the longer production run.

Sizes

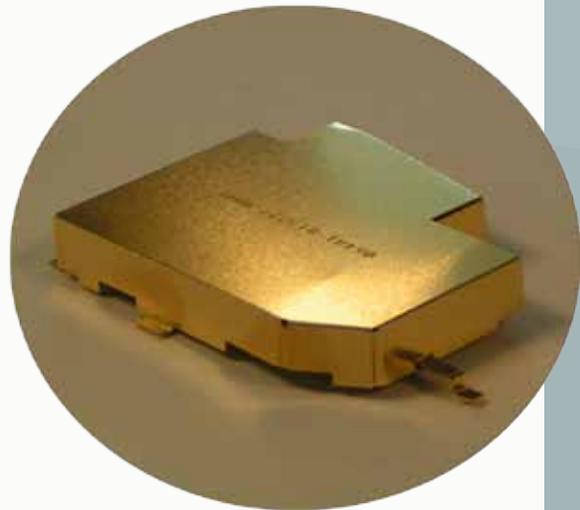
- Sizes of squares and rectangles from 0.50" x 0.50" to 6.00" x 6.00" in 0.25" increments standard
- Fence heights from 0.075" to 1"
- Odd shapes and custom shields also available

Options

- One piece construction for most applications
- Separate fence and lid configurations for easy component accessibility
- Mounting pins spaced at 0.25" or 0.50"
- Fences available with or without board standoffs
- Logos, part numbers, or other identification easily accommodated
- Ventilation holes, lead access notches, or other requirements easily added
- Variety of base materials available including copper, brass, stainless steel, and Alloy 42
- Variety of plating options available including nickel, tin, lead/tin

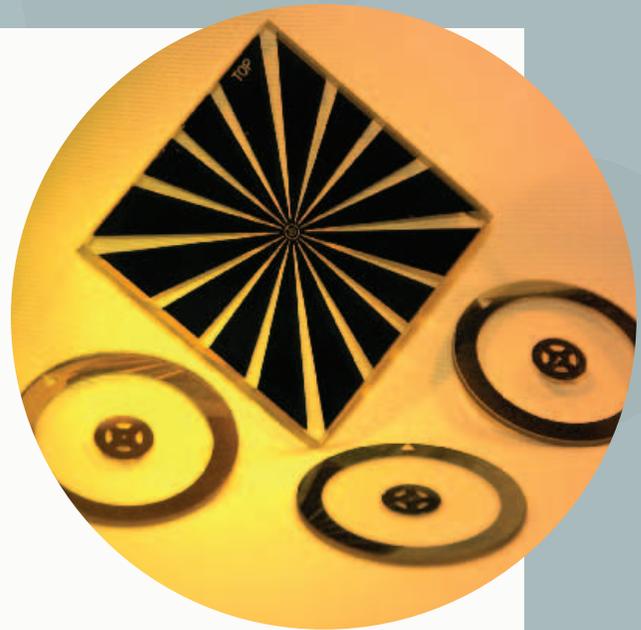
Standard Turn-Around Time

- For orders of 1000 pieces or less, 3-5 days



Glass Calibration Tools and Linear Scales

Thin Metal Parts (TMP) introduces the Glass Calibration Target product line, manufactured using the innovative Chrome-Etch Process. The TMP Glass Calibration Targets offer NIST Compliant **calibration tools** and **linear scales** for performing exact measurements.



Advantages

NIST Compliant: All Glass Calibration Targets are Certified through NIST procedures and meet the requirements of MIL-STD-45662.

Resolution and Feature Size: Standard resolution capability is 500 LPI and standard feature size is 15 microns. Greater resolutions and smaller feature sizes can be attained through custom design.

Lead Times: TMP's Chrome-Etch process allows for quick product turnaround times...generally within a 5 to 14-day period.

Dimensional Stability and Annual Calibration: Because TMP Glass Calibration Targets and Linear Scales are manufactured to NIST-compliant regulations, they offer consistency and dimensional stability. Annual re-certifications are offered with the TMP Glass Calibration Targets, along with Certificates of Compliance to document the re-certification accuracy.

Most Common Glass Calibration Tool Sizes

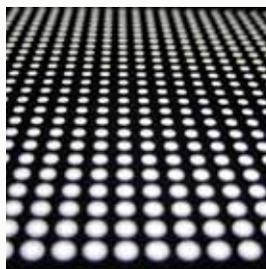
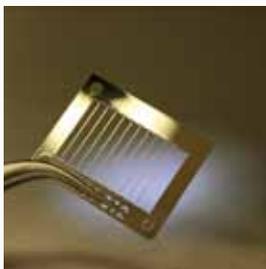
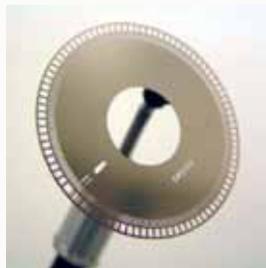
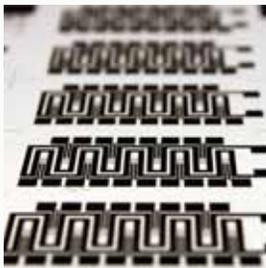
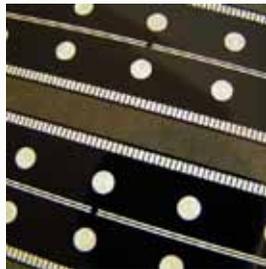
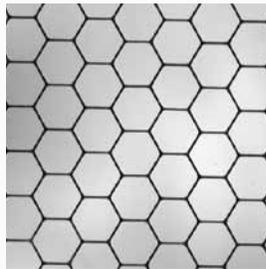
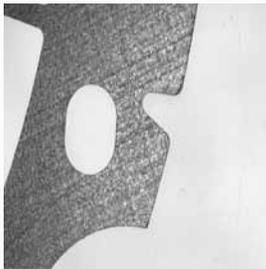
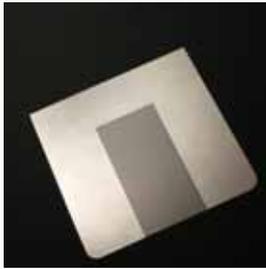
	Size	Glass Thickness	Feature Size	Feature Tolerance	On-Center/ Pitch
Typical	0.5 - 7"	0.02 - 0.06"	15 μm	$\pm 2 \mu\text{m}$	0.5 μm
Custom	up to 24x24"	up to 0.22"	3 μm	$\pm 2 \mu\text{m}$	0.5 μm

Quality Assurance

Thin Metal Parts is a certified designer and manufacturer of parts under ISO 9001:2008.



Thin Metal Parts Line Card



Encoder Wheels & Masks

Inkjet Nozzles

RF/EMI Shielding

Flat Springs

Flat Antennas

Reticles

Lead Frames

Filter Screens

Washers

Shadow Masks

Capillary Clips

Gears

Chassis

Chip Carriers

Evaporative Masks

Electrical Connectors

Waveguides

MicroGears

Heatsinks

Shuttle Blades

Decorative Brass

Optical Components

Electroformed Mesh

Electroformed Sieves

Imaged Glass

Imaged film

SMT Stencils

Vent Components

SMT Stencils

New Materials New Processes

Thin Metal Parts offers four performance stencil product lines, each with a unique feature set and designed to meet specific and differing printing needs throughout the industry. Using of a combination of new materials, new processing & coating, and the latest specialized equipment, TMP stencils are the next generation of SMT printing tools.

	Next-generation laser cutting technology	7-stage aperture polishing process	High-performance proprietary Alloy 9 material	Electroformed Nickel 11 material	TMP-LACH® ultra-performance surface coating
E-Form Plus®*	●	●		●	●
Alloy 9 Plus*	●	●	●		●
Alloy 9*	●	●	●		
True Laser	●				

* These stencils outperformed similar leading-competitor's products in independent testing

Nickel 11 electroformed sheet

TMP's exclusively developed and manufactured material is specially formulated to outperform other electroformed nickel stencil materials. Nickel 11 offers:

- Increased solder paste volume
- Better print-to-print consistency
- Custom stencil thicknesses in 0.00025" steps
- Improved release characteristics

Next-generation Laser technology

A new level of precision results in stencils with uniform apertures plus exceptional edge-to-edge performance.

- 25 micron wide fiber-source laser beam
- +/- 2 micron Axial Precision
- +/- 2 micron repeatability
- Custom motion algorithm ensures aperture wall profile is consistent across corners.

7-Stage aperture polishing process

An optimized combination of several cleaning and polishing stages significantly improves paste volume performance.

- Solder bricks are cleaner and more consistent from print-to-print.
- Does not sacrifice edge sharpness between stencil surface and aperture wall.

Alloy 9 material

This proprietary material offers a unique combination of properties which pair optimally with TMP's laser equipment. When compared to stencils made with other alloys and stainless steels, Alloy 9 offers:

- Smoother aperture walls
- Consistently cleaner solder bricks
- Reduced print defects

New Materials - New Processes

Applying the advanced technologies and equipment developed for the manufacture of high-precision parts, TMP stencils offer new levels of printing performance.

- Customized laser is the only of its kind in the U.S.
- All coatings are developed and applied in-house
- ODB++ file format is our design standard

TMP-LACH® ultra-performance surface coating

An electrodeposited coating that significantly improves stencil performance characteristics and lifecycle.

- Superior **Lubricity**
- Enhanced **Abrasion Resistance**
- Highly **Corrosion Resistant**
- **Improved Hardness**

Thin Metal Parts Systems

Communications

- Complete Customer Profile Records.
- Technical Services Representative review of order requirements.
- E-mail order acknowledgement through Skyline software.
- Check Plot available upon request.
- All orders are tracked online by each workstation from receipt to shipping.
- Daily notification of shipment tracking numbers.

Quality System

- All orders follow ISO 9001-2000 procedures for Design and Manufacture Internal Reworks; late shipments (if any) and customer returns (if any) are tracked and reviewed on a daily basis.
- All measurement equipment is calibrated with traceability to the National Institute of Standards.

Process

- Statistical Process Control Charts are established in critical areas such as Chemistry Tanks, Laser, etc.
- All measurement gages have passed Gage R&R studies. Accuracy checks are completed bi-weekly and tracked on X-bar Control Charts.
- Continuous improvement teams are actively improving processes based on Pareto Analysis of Top Issues.
- Regular coupon checks are completed using the lasers for Colorado, North Carolina, Mexico, etc.
- Processes are audited for compliance and for continuous improvements.
- Full Analytical Lab for Chemical and Process Control.
- Preventative maintenance is completed on all equipment.

Inspections

- Inspection stations are located before and after Final Assembly. Quality checks are performed and the results are recorded.
- The CAD software includes automated and manual Quality Checks, which are recorded and maintained as a Quality record.
- The CAD software includes many proprietary Design and QC Tools.
- A Scan CAD inspection is completed on laser cut parts to detect the presence of all features.
- Inspectors are required to pass an Inspector Certification process.

Environment

- Temperature and Humidity Controls are in place to achieve 1/16 mil accuracy for the Photo Process. In addition, clean rooms practices are used in the Manufacturing Area.
- Central high pressure Oxygen is used in Laser for smoother, more accurate walls.
- Process Flow is designed to better track product and reduce handling.

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