CAM-LEM INC
Freedom to Innovate

metaMETAL

Rapidly Machinable Metal Modeling Material

Machining Metal the Easy Way

What would you do with a material that was so easy to cut you can carve it with a knife, yet can be directly transformed into solid metal?

metaMETAL enables rapid prototyping and manufacture of metal components by avoiding the intensive effort required when machining solid metals. It works by substituting composite blocks of metal powder and polymer binder materials. Rather than tearing into metal, cutting tools only have to cut the plastic holding the powder together. Send your cut parts to a metaMETAL processing sinter where we remove the binder and consolidate the remaining powder into a solid component. The dense sintered parts look and perform just like parts made from the base metal. We send the finished parts back to you within a week.

Cutting MetaMetal is so easy that machining can be completed faster with no lubricants, stress, warping, or work hardening, minimal tool wear, and low tool forces. Use smaller diameter tools with longer cut lengths at higher feedrates and less worry about tool breakage.

The ease of machining metaMETAL helped one company quickly transform the three-dimensional computer model at top into an accurate thin-walled metal prototype part shown above within a few days and without requiring the time and expense of tooling.

How it Works

We supply various sizes of standard metaMETAL blocks. Apply a scaling factor to your desired dimensions to account for shrinkage during processing. Using any kind of cutting or milling equipment, machine a block into one or more parts. Then ship the parts to a metaMETAL processing center, and we'll process and ship back to you solid metal parts within about a week.

Applications

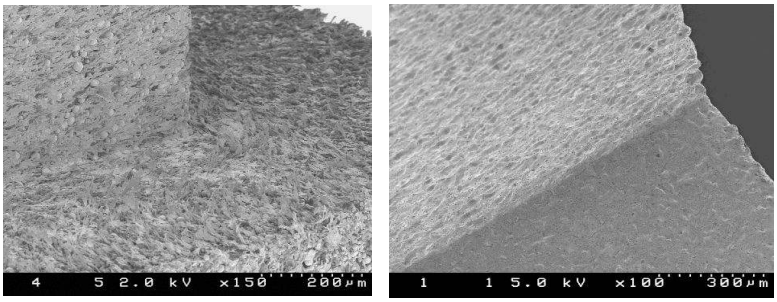
Prototyping stainless and other steel alloy parts

Enabling desktop CNC machines to make steel parts

Parts that are difficult to machine or cast
- complex or difficult features
- detailed or delicate designs
- thin walled parts
- small or irregular sized parts that are hard to hold

Machining hard-to-machine materials

Speeding up the machining process



Closeups of as-machined surfaces before (L) and after sintering (R). Edges are crisply defined, and the sintered surface is relatively smooth.

Benefits

For Manufacturing

Makes it easier to machine metal parts
Use smaller diameter tools with less tool breakage
Increase depth of cut and feedrates
Create better feature definition than most castings
Machine even very hard metals with ease
Less machining time leads to better resource utilization

For Product Development, R&D, Reengineering

Create prototype metal parts without tooling
Experiment with different materials more easily
Use prototype parts for performance testing
Design parts with greater complexity

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Process Capabilities

metaMETAL blocks can be cut, milled, turned, or machined with almost any cutting tool. In raw or "green" form the blocks can hold tolerances up to about the diameter of the metal powder (25 microns or 0.001 inches). The material is easy to machine yet rigid enough to preserve thin walls and high aspect ratio features. It's a direct-to-metal, "what-you-see-is-what-you-get" process, with no cleanup for sprues or gates.

Parts with sections 10 mm (0.4 inch) or more thick take longer to process since it takes longer for the decomposition products of the organic binder materials to diffuse through thicker sections of material. The maximum practical wall thickness is about 15 mm (0.6 inches), although green-state joining can be used to build up thicker parts.

A typical scaling factor to account for shrinkage is 1.16. The parts will shrink uniformly in all directions due to densification of the metal powder. Resulting parts will have some residual closed microporosity (around 5%) but will be gas-tight. Due to slight variations in powder loading, sintering temperature, and other factors, the general system tolerance for sintered metal parts is roughly 0.5 %. Improved tolerances are possible by refining the scaling factor to account for the particular batch of material, iteration, and careful control of sintering.
During sintering large overhangs may need support to help reduce slumping. Also, parts should have a flat side they can rest on during sintering. For example if a part stands on long legs then during sintering the body will shrink but the ends of the legs will remain about where they contact the sintering setter, causing distortion. These issues can be partly addressed through customized fixtures or setters.

After sintering, the steel alloy parts can be machined, polished,

Materials

Only 316L is currently supported. Other materials may be supported in the future based on demand.

STANDARD METALS
316L stainless steel

CUSTOM MATERIALS
Inconel 718, Titanium

AVAILABLE MATERIALS
17-4PH, 420, 440, 8620, M2, alumina ceramic, zirconia ceramic, ZTA ceramic

Material and processing costs and lead times will vary based on the material selected.

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Specifications

STANDARD BLOCK SIZES

MM-150:	152 x 76 mm (6 x 3 inches) 3, 6, 9, 12, 15 mm standard thickness 6 mm (0.25 inch) corner radius
MM-215:	215 x 190 mm (8.4 x 7.4 inches) 1.5, 3, 6, 9 mm standard thickness 12 mm (0.5 inch) corner radius
Tolerance:	± 0.2 mm on block dimensions

Ordering Examples:

MM-150-9
152 x 76 x 9 mm
6 x 3 x 0.35 inches

MM-215-3
215 x 190 x 3 mm
8.4 x 7.4 x 0.12 inches

TOLERANCE

Before processing parts can hold very good tolerances	± 0.025 mm (.001 in.)	
After processing tolerance depends on feature size	± 0.5 %	
Post-sinter machining can provide any possible tolerance		Unlimited
Surface finish		2.5 micron or better

CUTTING SPEED
For 1/8" end mill, 3-5 mm cut depth, 5000 RPM:

X-Y	20 mm/sec typical
Z	15 mm/sec or less

Cut speed is relatively independent of the material

MATERIAL PROCESSING (for standard materials)

Typical processing time	1-2 days
Turnaround time	Depends on timing of scheduled processing

SAFETY
Machining MetaMetal produces uniform shavings and virtually no respirable dust. The material is not toxic, but use the same precautions as you would for machining other plastic and metal materials.

All specifications represent typical values, and cannot be guaranteed for all materials and designs.