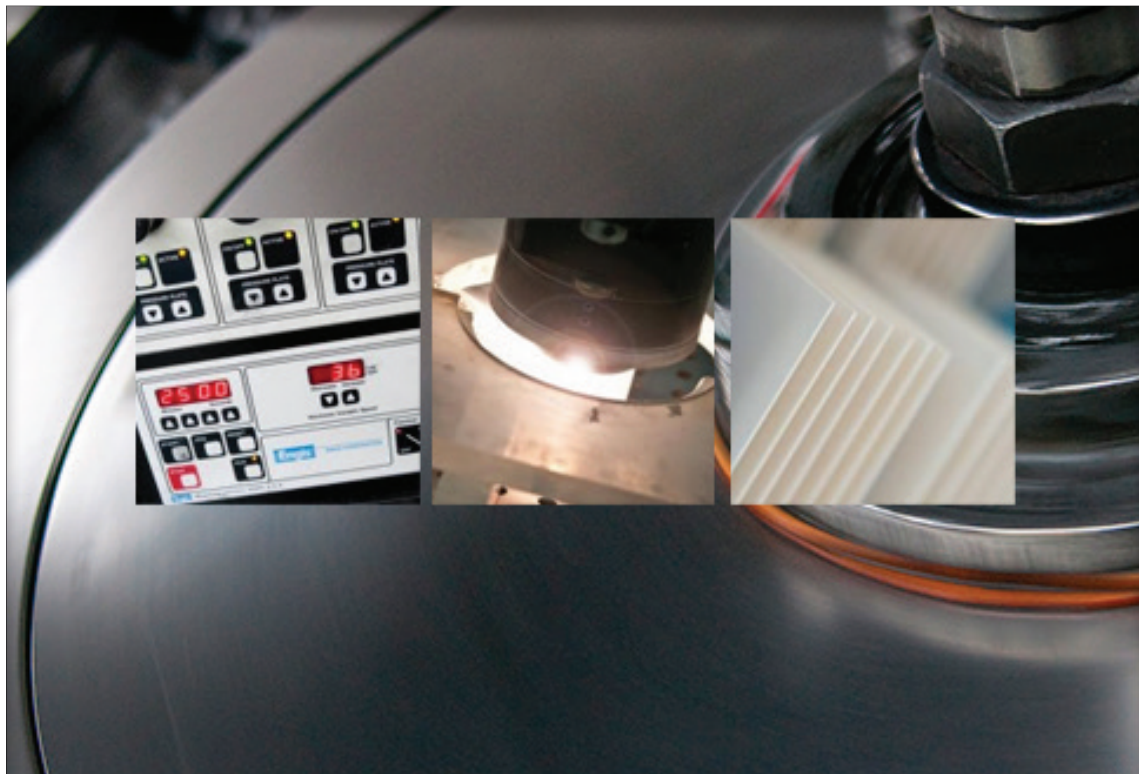


DESIGN GUIDELINE HIGH PRECISION LAPPING AND POLISHING

An Abrasive Machining Process





Lapping and Polishing are processes which are performed to achieve a desired surface finish, thickness, parallelism, flatness, and camber of any substrate. An application may warrant highly demanding tolerances that off-the-shelf stock or "as-fired" material simply cannot achieve. An example of this would be when it is necessary to have good vacuum hold down, better fit in holders and fixtures during processing, no warps or tears of masks, and intimate mask contact during printing, all resulting in better pattern and fine line resolutions with less yield loss.

In many cases, designs will require lapping only, polishing only, or a combination of the two. The lapping/polishing process is routinely performed and customized to accommodate the vast variety of materials, dimensions, and tolerances specified by our customers. Our comprehensive, in house services also includes laser cutting, laser welding, laser marking. We offer a "one stop" service for all our customers.

What is Lapping and Polishing?

Lapping is a machining process where an abrasive slurry is applied to substrates which are fixtured into lapping machines. While in the lapping machines, substrates are subject to the controlled and continuous movement of lapping plates. This controlled movement of these lapping plates result in material removal which can be controlled to within .0001". Different materials require different methods and unique processes to achieve the desired results. Accumet's processes achieve these desired results without introducing much stress or creating heat damage like other processes such as grinding typically do.

Polishing is also a mechanical process. Should polishing be warranted, a job would be moved to one of the many polishing machines housed at our facility once the lapping process has been completed. Instead of an abrasive slurry, a polishing fluid is introduced to the surface of the plate and the polishing process begins. The general purpose of polishing is to maintain parallelism and flatness while improving surface finish. Additionally, polishing will remove all surface scratches. A polished substrate will exhibit a glass-like surface. Our lapping and polishing processes are custom designed for each type of material and the physical dimensions required.

As the original lapping and polishing manufacturer, Accumet has always been known for high quality services. Accumet has developed several unique precision polishing and substrate lapping machining techniques that achieve extremely tight tolerances and repeatability from piece to piece. This is where decades of experience come into play. Choosing the appropriate abrasive, applying the exact amount of pressure, selecting the specific speed of machine and determining the batch size are all imperative when achieving customer specifications and tolerances. Using statistical process controls that conform to ISO and Aerospace standards, Accumet will provide you with a repeatable product from one lot to the next, again and again.

A vertical strip on the left side of the page shows a microscopic view of a substrate surface. It features a complex, dark, angular pattern against a lighter background, possibly representing a lapped or polished surface.

What is Flatness?

Flatness is the measurement of the peaks and valleys of one face of a substrate and it is measured from one point to another point of that face. It does not measure the curvature or discrepancies between both faces. Visualize a wedge-shaped part. It is possible to have an extremely face while having unparallel planes.

What is Camber?

Camber is the measurement of a substrate's curvature on both faces. Camber measures any deviation, bow and warp along the longest linear dimension. It is typically specified as an allowable bow within an "inch-per-inch" specification. For example, a typical "as-fired" substrate will generally hold a camber spec of .002 to .003 inch per inch. A lapped or polished substrate will generally meet camber of .0005 in / ". Ideally a part with perfect camber would be completely uniform in thickness and would lay flat against a surface without restraint. Poor camber would be evident if you were to press down on one corner of a substrate and the other corner (s) would pop up. We call it the potato chip effect.

What is Parallelism?

Flatness, as discussed above, pertains to an individual face of a substrate, measuring from edge to edge of the same face. However, just because you have two flat sides, it does not necessarily mean that these sides are parallel to each other. Again, visualize a wedge-shaped part. Thus, we measure and ensure parallelism between the two sides (faces).

What Tolerances Can be held?

As a general rule, thickness tolerances hold as tight a .0002" and surface finishes ranging from 1 micro-inch to 60 micro-inch can be repeatedly achieved by our lapping and polishing processes. For the thinner materials, such as our .003" thick 99.6% alumina substrates, we routinely hold a thickness of $\pm .00025$." Flatness is another crucial benefit from lapping and polishing. Accumet is capable of holding flatness as tight as .00015." We are experienced, precise, and very capable of delivering substrates in R&D quantities as well as production quantities. Consistency and repeatability are what we've built our reputation on. The lapping process does introduce some stress to a substrate by abrasively grinding material away from both sides of the plate. Because of this, the desired thickness, length and width all dictate what is achievable in terms of flatness and camber. For example, for parts .015" and thinner, parts need to be measured while under a restrained state as simply holding a board that thin would create excessive, yet temporary camber.

How to ensure your specifications are met?

When placing an initial request for quote, you should include the following within your request. First, you need to specify a thickness tolerance. For example: .025" thk \pm .0025." In addition, specify surface finish requirements, flat and parallel requirements, and camber specifications.

What are achievable surface finishes?

The guide below shows the achievable surface finish tolerances for each material we process.

	Thick Film 96% Alumina	Thin Film 99.5% & 99.6% Alu- mina	Thin/Thick Film 99.5% BeO	Thick Film 170 W/mK AlN	Thin Film Fused Silica (Quartz)	Thin Film Sapphire
As-fired	15-45 μ m	4 μ m Side A 5 μ m Side B	15 μ m MAX	8-24 μ m	N/A	N/A
Lapped	20 μ m Nominal	10 μ m Nominal	20-40 μ m	25 μ m Nominal	7 μ m Nominal Matte Finish	15-20 μ m
Polished	5 μ m MAX	1 μ m MAX	4 μ m MAX	2 μ m MAX	60/40 Optical (0.1 μ m)	60/40 Optical (1 μ m CLA)
Standard Thickness Tolerance	\pm 10% As-Fired \pm .001" Lapped \pm .0005" Polished	\pm 10% As-Fired \pm .001" Lapped \pm .0005" Polished	\pm 2% As-Fired \pm .001" Lapped \pm .0005" Polished	\pm 10% As-Fired \pm .001" Lapped \pm .0005" Polished	\pm 10% As-Fired \pm .001" Lapped \pm .0005" Polished	\pm 10% As-Fired \pm .001" Lapped \pm .0005" Polished
Minimum Stock Removal for Lapping	.010" Minimum	.010" Minimum	.010" Nominal	.010" Nominal	.010" Nominal	.010" Nominal

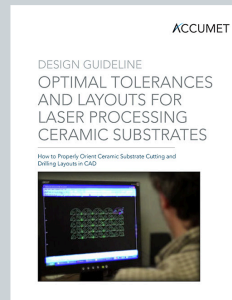
Can Lapping and Polishing help with Filled Via Surface Planarity?

When plating through holes in a printed circuit board, sometimes vias are filled irregularly. The result is raised bumps along surface of board. There was a time where this was not a problem, but in the age of surface mount components, surface planarity is critical. This is because adjacent, low-profile components may be affected by the surplus of metal. Since Accumet is the pioneer of lapping and polishing ceramic substrates, it makes perfect sense that Accumet is very skilled at making filled vias co-planar with the surface of the substrate.

Accumet Design Guideline:
High Precision Lapping and Polishing

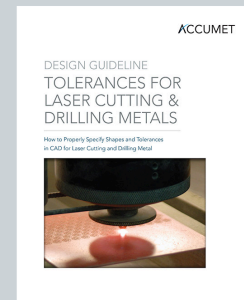
Additional Materials Processing Capabilities:

We have the equipment and materials to be your trusted resource. We can do so much more than lapping and polishing. See our additional [capabilities](#) and download our other [resources](#) for more information.



Laser Machining Ceramics

[Download](#)



Laser Machining Metals

[Download](#)

Equipment:

Accumet owns and operates over 15 lapping machines (including double-sided lappers), 9 polishing machines, an edge grinder, dicer, and 25 laser systems including CO2, Yag and Fiber lasers. We have micro-positioning tables, multiple beam systems, and statistical process controls to get your parts done perfectly. And with up to 2200 watts of CO2 energy, 2000 watts of fiber energy and 400 watts of Yag energy, you can rest assured we have the power and adaptability to get the job done right.

Materials:

Accumet offers the service of procuring and maintaining inventory on a wide variety of materials. We are also happy to receive, store and machine customer-supplied materials for individual or blanket orders.

Quality

"Our commitment to offering our customers top quality product, consistently, on time is at the heart of everything we do." said Greg Sexton, CEO of Accumet. "Maintaining our ISO9001:2015 and AS9100 certifications is always very important to us and our customers because it confirms we adhere to the strictest quality standards put in place by the aerospace industry in order to satisfy FAA, NASA and the DOD," added Sexton. You may view and download Accumet's ISO9001:2015 AS9100:2016 certifications [here](#).

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Industry Applications

Lapping and polishing finishing processes are used in countless industries and applications, including:

- RF and microwave electronics
- Aerospace
- Ceramics
- Medical components and devices
- Valves, tools and mechanical products
- And so much more...

Recognizing the need for one-stop precision substrate machining, Accumet also offers high performance laser machining in addition to lapping polishing services. These new capabilities extend beyond simple scribing. Accumet provides the most extensive laser services in the industry including laser cutting, laser drilling, laser welding for a wide variety of complex shapes, multitudes of vias, and add-value post-processing services.

Let's get started.

Please submit all requests for quotation to sales@accumet.com. Please include DXF (preferred file format) or pdf, tolerances, include the type of material, whether or not you will be supplying material or if you would like Accumet to supply it (and therefore include material in pricing), quantities and any specific finishes.

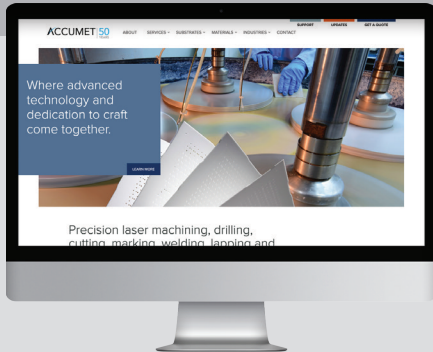
About Accumet

Founded in 1970, Accumet is an ISO 9001 industry pioneer and AS9100 certified advanced materials processing powerhouse. Accumet offers expert engineering support and proven manufacturing techniques for laser drilling, laser cutting, laser marking, laser ablation, laser welding, lapping, polishing, and diamond sawing. Fifty years after its founding, Accumet manufactures millions of top quality products and parts for over 400+ customers annually, with 95% on-time delivery and less than 2% defects. Because of these results, Accumet is widely recognized as a trusted "go-to" manufacturing partner with quality, speed, and reliability at its core.

Accumet can quickly fulfill small minimum orders or large production runs from their vast inventory, or process customer-supplied materials. Either way, Accumet utilizes advanced technologies, quality materials, and skilled expertise to help customers innovate products better, faster, and more efficiently with higher yields. Materials and parts can be expertly custom made to nearly any size or shape with a wide variety of surface finishes. Accumet has the flexibility to efficiently manage the smallest custom projects to the largest complex jobs—and the engineering expertise to add value at every step. Accumet supplies [medical and bioscience](#), [RF/microwave and microelectronics](#), [aerospace and defense](#) manufacturers and many other industries throughout the United States from two facilities just north of Boston, Massachusetts.

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NEXT STEPS



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