What is Micro Molding?

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Micro-molding is a highly specialized manufacturing process that produces extremely small, high-precision thermoplastic parts and components with micron tolerances.

The process starts in a tooling department where a mold is created that has a cavity in the shape of the part desired. Thermoplastic or resin is rapidly injected into the cavity, creating the component or part at high speed.

Engineering Focus

Within engineering circles, there has been a substantial increase in interest from designers and manufacturers in producing and procuring high-precision, micro-featured plastic parts. The result has been countless articles in the trade magazines addressing this new niche in the injection molding industry containing many differing definitions, creating some confusion.

How is micro molding classified?

The term “micro” suggests that micro-molding has something to do with size, but it’s important to understand the criteria that separate “small” from “micro.”

Weight under one gram is in the ballpark, but the overall size and weight is only one apsect. Molding something “small” isn’t all that challenging, therefore it wouldn’t qualify as micro molding. To qualify, a component must be micro in size but also molded precisely, time and time again, maintaining micron tolerances.

When engineers think micro molding, (or micro moulding for our European friends) they aren’t thinking of an off-the-shelf “micro molding” machine. They expect manufacturing technology and a DfMM process capable of producing thousands, millions, and even billions of parts with the exact same precision.

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Micro Molding Overview

Micro Molding
overview

Overview on size

Not every application requires microscopic parts. Many times an OEM or manufacturing partner has a small molding project that requires demanding geometry and tight tolerances.

For example, a part measuring about an inch long can have many micro-sized features like a 0.004” (.1mm) thin wall section, a 0.008” (.20mm) diameter hole, etc. These features can be extreme, and a micro-molder will apply the skills and expertise from successful micro-molding to these “larger” parts.

Machines aren’t enough

Today anyone can buy an injection press from a variety of manufacturers. Many of them even advertise special presses just for “micro molding.” However, a micro-molder is not classified by hardware alone.

The combination of robotics, processing, packaging, inspection, expert tool building and expertise in resin and plastic chemistry makes up the elements of true micro molding. In the same way, buying a Steinway piano doesn’t make one a virtuoso, it takes years of experience to master the micro molding process.

Micro Molding Categories

Another key ingredient for any micro-molder is the ability to perform other traditional injection molding processes at the micro scale. The demand for micro-sized lead frame, optics, and insert molding continues to grow, and the same size and tolerance requirements of standard micro-molding apply to these processes as well.

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Micro Molding Categories

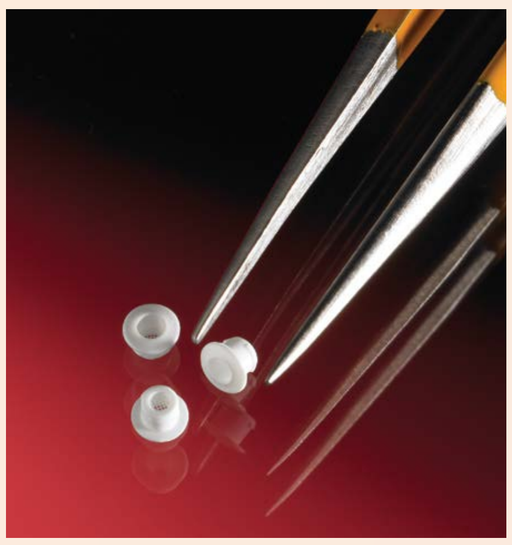
Micro Molding
Categories

Insert / Lead Frame

Insert micro-molding applies to more than just metal inserts, but also applies to a wide variety of other materials such as ceramic, glass, fabrics, film, or foil to other plastics. A DfMM engineer working with a fabric insert, for example, must carefully position the filter at the part's center, successfully feed, cut, position, and shut-off on this unstable and delicate material suspended in the mold. The molding process requires repeatable control to avoid damaging both brittle or fragile materials while maintaining the tight tolerances of the part itself.

Lead Frame

Micro Insert



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Micro Molding
Categories

2-Shot

Simultaneously molding two different materials on the same part is called 2-shot micro molding. Two thermoplastic resins are shot in sync, requiring only one mold cycle. Often times this process can add valuable cosmetic or functional properties, reduce labor or assist in making the part more robust.

The image above has a soft durometer material in the center, surrounded by a hard ABS structural material. This part is molded in one mold eliminating the need to build two parts and assemble them or two tools and insert mold one material on the other, saving time and resources.

2-Shot

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Micro Molding
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Micro-Optics

The micro-optics market isn't just a product for the telecommunications market. Products like medical diagnostics, endoscopic and minimally invasive surgical tools, and micro sensor applications are taking advantage of these tiny lenses.

The image to the right is a 12-lens array for the high-bandwidth data market. It's made of Sabic's Ultem® material. Each lens is 250µm in diameter on 250µm centers. The noncumulative positional tolerances of each lens from the datum post is ±3µm.

Lens Array

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In-House Processes

In-House Processes

Tooling & Production

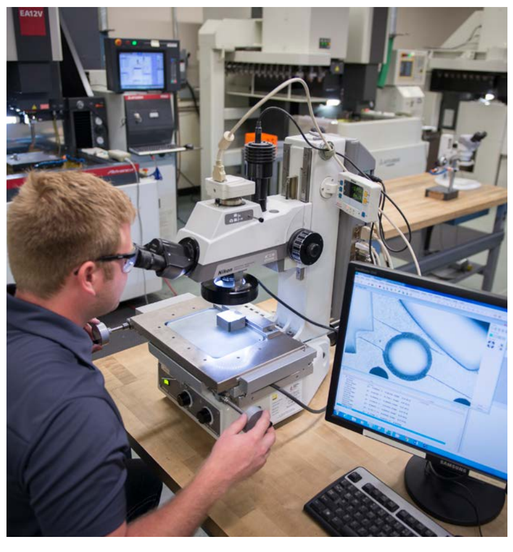
Control of the mold design and build process is essential to the success of any micro-molding project. Having in-house tool design, build, and maintenance resources is a significant advantage when dealing with extremely tight tolerances and complexities of the parts we have already mentioned.

Making good parts on time, every time, requires experienced in-house tooling, design engineering, project planning, process engineering, and quality engineering resources. This assures a fully developed design for manufacturing. It would be very difficult to outsource these responsibilities with manufacturing projects this complex.

The in-house tool makers are integral members of the project management team, as are the quality technicians and process engineers. The team must plan and execute many sophisticated production processes while maintaining strict project timelines. The need for clear ongoing communications all along the way is essential.

In-house resources also play a critical role in routine maintenance, running product changes, or repairs that may be required.

Tooling Engineer



Production Staff

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In-House Processes

Automation & Packaging

Part handling and packaging can be just as important as making the part. Packaging a part so it's oriented in a manner that's useful to the customer can be a challenge all on its own.

In-house custom automation and packaging could be reel-to-reel packaging, light subassemblies, lead frame die-forming and singulation, in-line inspection, or a wide variety of other custom secondary processes. These added services can be the difference between project success and failure.

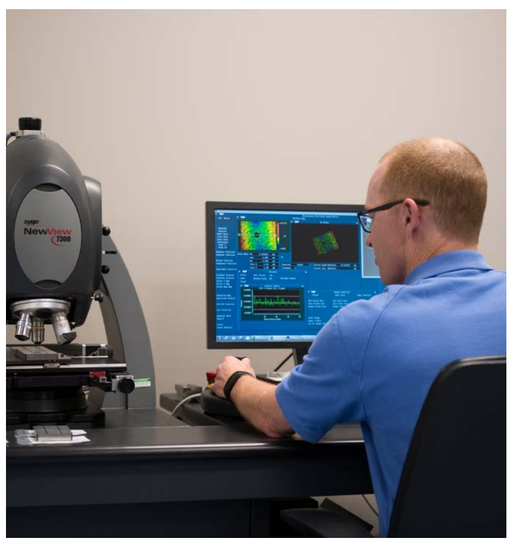
Measurement and Validation

The ability to prove that parts are made to spec time and time again is where true capabilities are tested. Design for manufacturability reviews are performed to ensure the project is off on the right foot.

Depending on what's appropriate, measurement plans using precision gauge pins and high-resolution in-line vision systems may be employed where necessary. Verification of tool dimensions as well as finished part dimensions often requires high magnification microscopic measurements.

Packaging System

White-light interferometer



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Product handling

Product handling is also a necessary consideration. Surface contamination can be, at a minimum, a nuisance for parts this size. Delicate features need proper processes in place to make sure the product arrives to the customer undamaged. Automation and clean room molding may be required.

Material Selection

Micro molding materials come in almost as many forms as there are ideas in the mind of a Mechanical Engineer. In the world of micro-molding, mission-critical components often require exotic or highly engineered compounds.

Materials like PEEK, PEI (Ultem®), carbon-filled LCP, or glass-filled nylons are commonplace. Soft durometer or elastomeric resins are also prominent. Direct experience with these materials in the context of micro-molding is valuable in maximizing the performance of the resin/part design combination.

Lexan® with colorant

Ultem®

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Final Notes...

When it's all said and done, it's about the finished component or assembly. An authentic micro-molder produces extreme parts consistently and efficiently every time. A true micro molder is ultimately there to meet the high demands of modern manufacturing. The artistry and ingenuity in the process is lost if, in the end, the product does not satisfy the customer.

Even though micro molding may seem new and novel, Accumold has been in the "micro" business for more than two decades and has produced billions of micro molded parts over the years. It's where we started as a company, and it's where we continue to grow, innovate and produce.

True micro molding is our way of thinking, our way of doing, and our way of life. Please reach out today if you have questions!

accu-mold.com
1711 SE Oralabor Road Ankeny, IA 50021 USA • +1 515-964-5741
micromolding@accu-mold.com

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