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WHITE PAPER

MOLD SOLUTIONS

Multiple Mold Solutions with Hi-Speed SLA

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As the Additive Manufacturing (AM) landscape advances, Axtra3D has established itself as a leader in Concept Injection Molding with its Hi-Speed SLA technology platform. It has successfully installed 10s of systems that particularly target Concept Injection Molding™ with ceramic mold inserts using the Ultracur3D™ RG3280 material.

With the launch of four new Concept and Low Volume Production Molding Solutions, Axtra3D is broadening its portfolio to include a wider range of mold solutions beyond just injection molding.

With these new offerings, the Lumia.X1, powered by Hi-Speed SLA technology, now enables production across **four distinct molding solutions.**

MOLD SOLUTION	**Investment Casting Molds**	Ultracur3D RG 3280 Ceramic
	Low Pressure Molds	Ultracur3D RG 1100
	High Temperature Micro Molds	Figure 4 HI TEMP 300-AMB
	Silicone Molds	Ultracur3D ST 45 Black

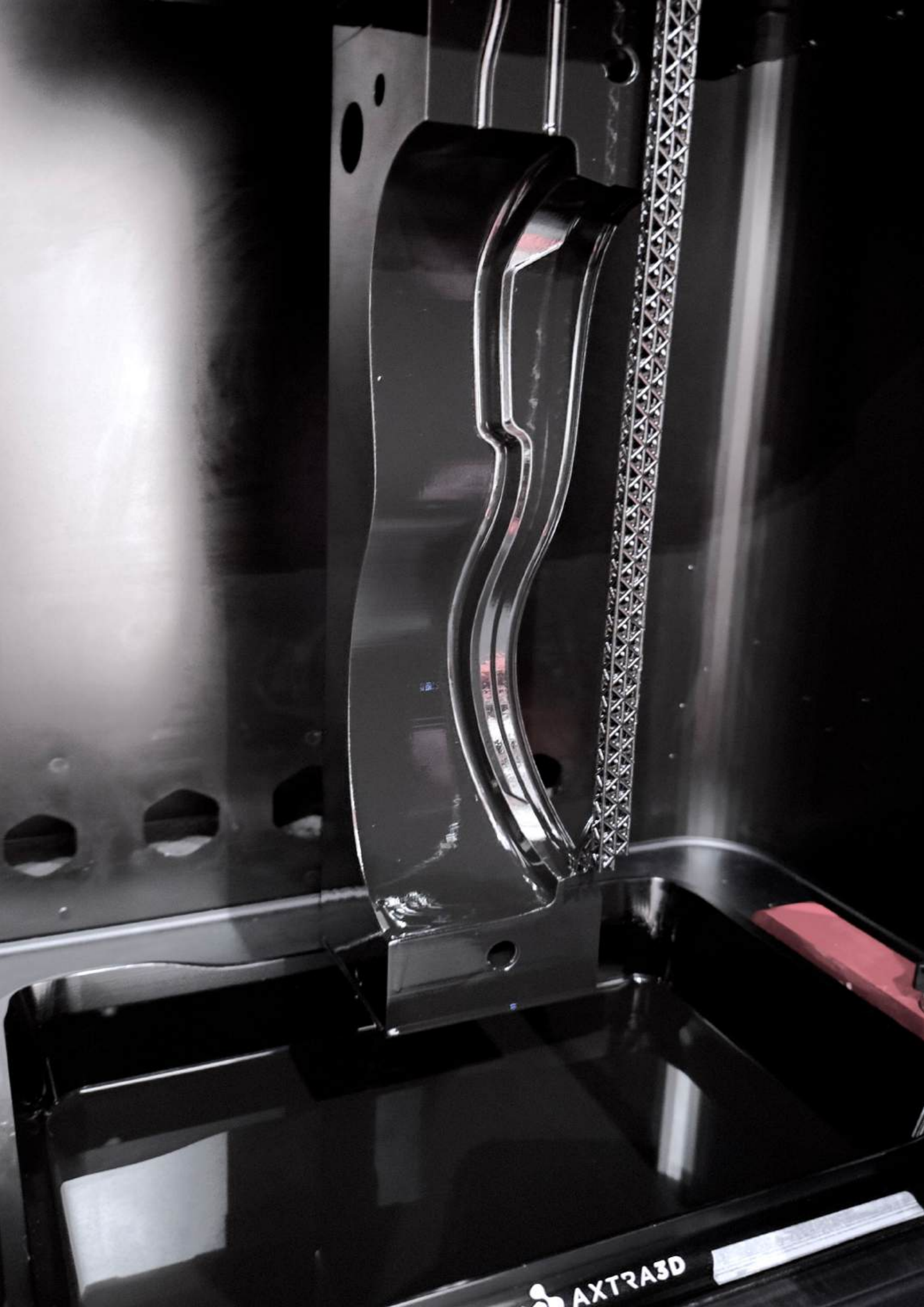
With this expanded molding solutions portfolio, the Lumia.X1 can produce molds for a diverse array of processes, including traditional injection molding, low-pressure molding for viscous materials, micro-molding for high-temperature materials up to 300°C, and specialized silicone molding, all ideal for concept development, new part prototyping, or low-volume production.

This gives Axtra3D the leading position in Mold Solutions for Low Volume Production.

Overcoming the Challenges of Traditional Metal Tooling

While metal tooling has long been a standard in manufacturing, it poses limitations that clash with today's demand for agility and precision:

- **High Costs and Long Lead Times:** Metal mold manufacturing cycles are costly and time-consuming, creating barriers for rapid production. It takes weeks and months to create metal molds lengthening time-to-market.
- **Precision Compromises:** Even minor inaccuracies in metal tooling can lead to inefficiencies and additional expenses.
- **Barriers to Low-Volume Production:** For short production runs or frequent design changes, metal tooling is impractical due to the significant costs involved.
- **Restricts Design Iteration:** Due to the costs and time cycles, quickly iterating through design cycles is very prohibitive.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The 3D Printed Alternative with the Lumia.X1

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In contrast to the traditional metal mold approach, 3D Printed mold inserts from Axtra3D's Lumia.X1 are designed to overcome these challenges, offering a quicker, more precise, and cost-effective solution for manufacturers needing both prototype and low volume production ready molds.

At the heart of the solution are specific materials for each of the mold solution, paired with Lumia.X1's Hybrid PhotoSynthesis™ (HPS) technology - which offers high resolution, precision, and print speeds that surpass other SLA 3D printers - the combination yields isotropic molds ideal for each of the respective molding process.

This is possible due to three fundamental design elements integral with LumiaX1's Hi-Speed SLA process.

Hybrid PhotoSynthesis (HPS) combines a laser with DLP to image internal and external structures simultaneously. DLP covers large areas for high throughput, while the laser ensures high resolution on detailed sections. This dual approach enables the Lumia.X1 to achieve SLA-quality prints at the speed of DLP/LCD systems.

TruLayer Separation allows for rapid layer transitions by quickly detaching the active print layer, minimizing hydrostatic forces and reducing wait times. This innovation enables the printing of large, complex parts with smooth, glass-like finishes directly from the printer. This is especially important when printing with viscous silicone materials.

TruLayer Adaption ensures consistent resin thickness by dynamically adjusting the glass plate's flatness which eliminates prolonged curing times and guarantees uniform quality across all layers.

These capabilities provide substantial advantages for molding applications:

Fast Turnaround for Mold Inserts: Capable of producing inserts up to 18 inches tall, the Lumia.X1 completes a 5" x 5" mold set in under three hours, dramatically reducing lead times.

High Surface Finish and Precision: With a surface flatness of ±20 microns on key areas, the Lumia.X1 minimizes post-processing, ensuring molds and their mating features are ready for use upon printing.

Unmatched Reliability and Repeatability: Consistency is essential in mold production, and the Lumia.X1 ensures repeatable accuracy of ±50 microns across the print area.

Flexibility for Complex Geometries: The Lumia.X1 allows intricate designs without added cost, making it an ideal solution for complex mold iterations.

Scalability for Low-Volume Production: The cost-per-mold ranges from $80-$300, depending on size and solution, making it a practical choice for small-batch runs.


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A Mold Solution for Every Need

With this expanded molding solutions portfolio, the Lumia.X1 can specifically produce molds

- Traditional injection molding
- Low-pressure molding for viscous materials
- Micro-molding for high-temperature materials up to 300°C
- Silicone molding for industrial and healthcare applications
- Sacrificial Water-Soluble molds for very complex geometries

1. Concept Injection Molding with Ceramic Mold Inserts

he Lumia.X1 revolutionizes Concept Injection Molding™ by utilizing ceramic mold inserts made from Ultracur3D® RG 3280, a ceramic-loaded polymer. This approach addresses the high costs, long lead times, and limitations of traditional tooling methods. The entire process, from CAD design to the final injected part, can be completed in just one business day. This rapid turnaround is achieved through a streamlined workflow involving a brief design phase, quick printing, minimal post-processing, and no post-printing machining.

The cost-effectiveness is clear, with mold inserts typically ranging from $100 to $250 per set, making it ideal for low-volume production and prototyping with end-use materials. The ceramic-loaded polymer offers high stiffness, temperature resistance, and durability, enabling the production of high-quality molds that can withstand 300 to 3000 injection cycles, depending on the material and geometry. This capability promotes rapid iteration and innovation, allowing companies to quickly transition from concept to production-ready parts in PPE, PC, ABS, TPE, and TPU.

Prominent service bureaus like Protolabs and Met-I-Flo, which focus on prototyping and low-volume production, have found significant value in this solution. After a thorough evaluation of various DLP-only technologies, Protolabs chose the Lumia.X1 for its ability to produce high-toughness, high-rigidity inserts with precision and speed, giving them a competitive edge in mold manufacturing. Met-I-Flo is successfully injecting more than 500 parts per mold set and excelling in low-volume production.


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2. Low Pressure Molding with Durable Ultracur3D RG 1100

Highly viscous, rubber-like materials are not ideal for injection molding and require low pressure molding techniques. While the Lumia.X1 provides all the part fidelity and precision to create accurate molds, its print throughput that is at times 20X conventional SLA makes the solution fast and financially viable.

Ultracur3D RG 1100 offers exceptional stiffness for structural integrity and the mold can be printed up to a length of 19" (499mm.) The high-strength polyurethane-based engineering grade resin has mechanical properties comparable to injection molding grades used in automotive. With a high-heat deflection temperature of 116°C and excellent chemical resistance it is ideal for low pressure molding of highly viscount materials. Its low water absorption characteristics further aid in maintaining its accuracy through the molding process.

For example, the use of 3D Printed molds reduced mold production time in large 12" (304mm) from 8 weeks to just a few days, allowing faster prototyping, testing, and iteration to keep pace with the dynamic footwear market. This approach lowers mold creation costs, enabling multiple, cost-effective prototypes and promoting rapid innovation. Additionally, 3D printing allows for easy design modifications, boosting agility in development. The solution delivers the durability and precision needed for reliable polyurethane foaming in high-quality footwear manufacturing.


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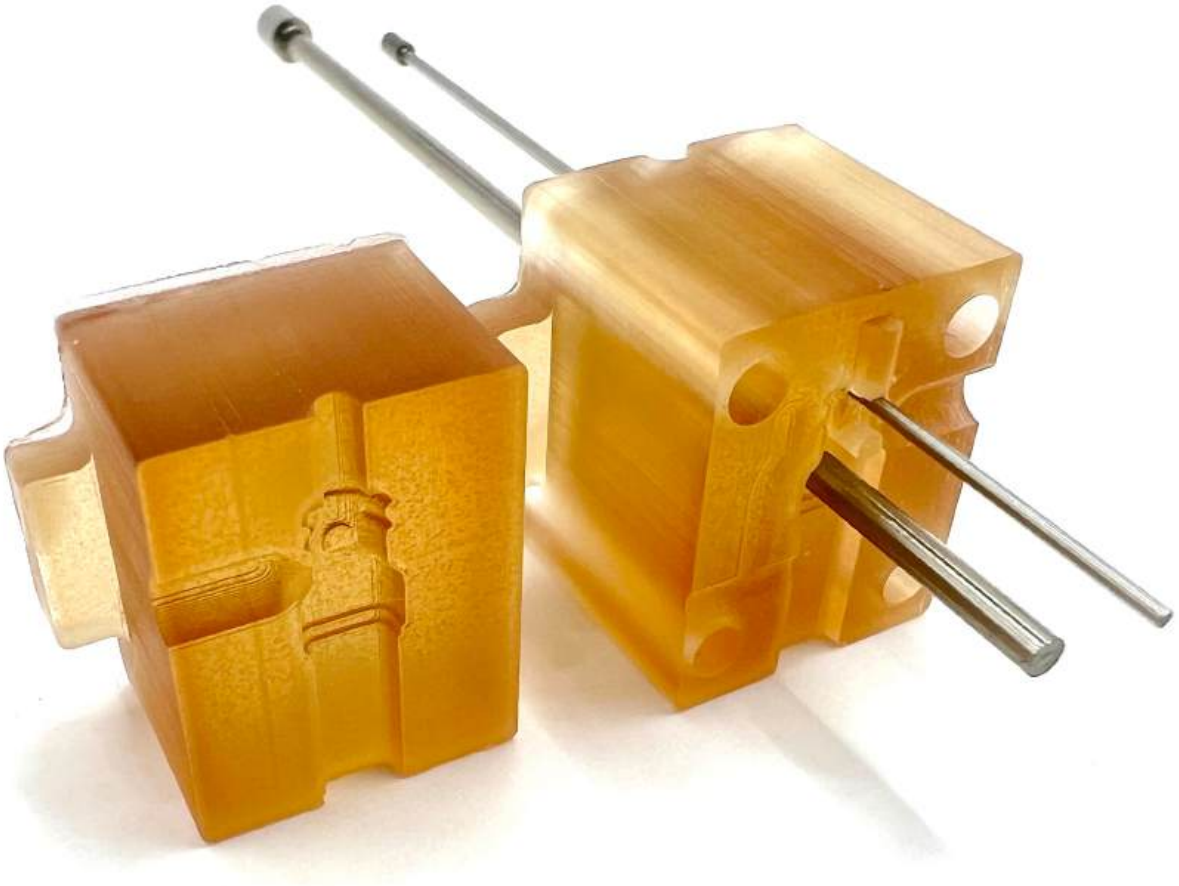
3. High Temperature Micro Molds with Figure 4 HI TEMP 300-AMB

High-temperature molding is essential in industries such as automotive and aerospace, where materials must withstand significant thermal stress. Additionally, there is a demand for highly complex, small parts in the automotive and durable goods sectors. The Lumia.X1 addresses this need by enabling precise, durable micro molds using Figure 4 HI TEMP 300-AMB material.

This production-grade material, with a heat deflection temperature (HDT) exceeding 300 °C under both low and high stress, is ideal for intricate molds within a 4” x 4” x 4” (100 mm) volume. Its rigidity, coupled with a high tensile modulus of 4000 MPa, makes it an optimal choice for low-pressure micro molds.

Furthermore, this material does not require thermal post-curing, and its translucency allows for ideal visualization, which is valuable for evaluating internal features and fluid flow performance in parts.

Molds within a 4” (100 mm) size box, produced by Lumia printing, are completed in under two hours and require minimal post-processing. They can be used with or without ejector pins to facilitate injected part removal.



4. Silicone Molding with Ultracur3D ST45 Black

BASF's Ultracur3D ST 45 Black resin is a robust material specially formulated for high-precision industrial applications. Ideal for molds intended for silicone casting, it offers high tensile strength, thermal stability, and a smooth surface finish. This resin endures the mechanical stresses of repeated silicone injections, maintaining dimensional accuracy and integrity even after numerous casting cycles. Its scratch-resistant property aligns particularly well with the requirements of silicone parts that demand a smooth finish.

The Lumia.X1 provides a unique advantage in achieving ultra-precise geometries, essential for producing molds with fine features that capture the exact details of silicone parts. This precision translates directly to the final silicone products, offering an unmatched level of accuracy in complex designs.

Key benefits of the Lumia.X1 and Ultracur3D ST 45 Black combination include:

Material Compatibility: High-performance materials like Ultracur3D ST 45 Black resist silicone adhesion and maintain structural integrity, ideal for repeated casting cycles.

High Precision and Detail Reproduction: With the high-resolution printing capabilities of the Lumia.X1, molds capture fine features in detail, allowing silicone to flow into tight spaces and replicate even the smallest design elements. This is critical for healthcare components, consumer products, and custom parts.

Thermal Stability: Silicone molding often involves heating and cooling cycles; thus, molds must withstand these temperature variations without warping or degrading. Ultracur3D ST 45 Black's durability and heat resistance maintain accuracy over multiple production cycles.

Ease of Demolding: Silicone parts release easily from molds without tearing or deforming, as the printing process ensures smooth mold surfaces with a surface finish tolerance of +/-20 microns.

Consistency and Repeatability: Molds produced with this combination deliver consistent results with minimal variation across batches, ensuring high-quality end products for regulated industries, such as medical devices in healthcare.

Axtra3D: Redefining Mold Production for Industry Leaders

For companies looking to quickly adapt to changing market demands, Axtra3D's Lumia.X1 delivers a transformative solution for mold insert printing.

Whether in concept injection molds, low pressure molds, high-temperature molds, specialized silicone molds or sacrificial molds, the Lumia.X1 offers unmatched versatility, quality, and cost-efficiency, making it an ideal solution for today's mold leaders.

Start your HPS evaluation: *www.axtra3d.com/inquiries*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