AXTRA3D

WHITE PAPER

TRUE SILICONE SOLUTIONS

Unlocking Precise True Silicone Solutions: The Lumia.X1 Breakthrough

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The demand for advanced materials in healthcare and industrial applications has driven significant innovation in 3D printing technologies. Among these materials, true silicone stands out due to its biocompatibility, durability, flexibility and precision, making it an ideal choice for a wide range of applications.

Importance of True Silicone Parts in Healthcare and Industrial Applications

Composition

Unlike other so-called "silicones" that rely on epoxies, acrylates, urethanes, or catalysts, TrueSilX50 is a pure silicone formulation. The backbone and the crosslink structure, i.e., the polymer matrix, are both made entirely of silicone, with only additives included to enable the 3D printing process. What's more, post-processing in a cleaning solution removes uncured silicone and the additives used for the 3D printing process, resulting in 100% silicone parts.

Biocompatibility

TrueSilX50's entire backbone of the polymer comprises silicone, i.e. free from acrylates and urethanes. This allows them to achieve biocompatibility requirements more easily. Besides applications that require higher flexibility or elasticity, the parts also benefit from using silicone compared to other materials or silicone-hybrids. TrueSilX50, outperforms all other low viscosity 100% silicone photopolymer formulations, e.g. in key properties like tear strength. Hence, they can be used for biocompatibility-related applications, e.g. in healthcare or audiology. These silicones pass biocompatibility tests according to ISO10993, for non-cytotoxicity and non-skin irritation. As the biocompatibility requirements often depend on the end application, we partner with our clients in bringing the product to the market.

Durability and Flexibility

It exhibits remarkable durability and flexibility, enabling it to maintain structural integrity under various conditions. In industrial applications, this translates to enhanced performance in components subject to stress, wear, and environmental exposure. Its resistance to chemicals and UV light also ensures longevity in diverse operating environments.

Precision and Customization

The ability to produce highly precise true silicone parts through 3D printing allows for tailored solutions that meet specific requirements. In healthcare, customized implants or prosthetics can significantly improve patient outcomes, while in industrial applications, precise components can enhance efficiency.

Producing Silicone Parts using Traditional Manufacturing

Producing silicone parts traditionally poses significant challenges, primarily due to the need for custom molds, which are costly and time-intensive to create, especially for low-volume runs. Mold limitations restrict design flexibility, making complex geometries difficult to achieve. Additionally, high mold costs hinder rapid design iteration. The process also generates considerable material waste, particularly early in production, increasing costs and raising environmental concerns.

Challenges in Production of True Silicone Parts via Photopolymerization 3D Printing

Several challenges have hindered the accurate and consistent production of these components using 3D printing photopolymerization techniques.

Material Properties

True silicone possesses unique rheological properties that can complicate the printing process. Achieving the desired viscosity and flow characteristics is crucial for ensuring that the material can be accurately processed during the printing process. Inconsistent material behavior can lead to defects, such as poor layer adhesion or incomplete curing.

Print Resolution and Detail

Achieving high resolution and fine details in silicone parts can be challenging with traditional photopolymerization methods. Technology often struggles to maintain precision in the z-axis, which can result in dimensional inaccuracies in the final product. This lack of fidelity can compromise the functionality and performance of parts in critical applications.

Curing Process

The photopolymerization process relies on UV light to cure the material. However, the curing depth and speed can vary depending on factors such as layer thickness and material composition. Inconsistencies in the curing process can lead to variations in mechanical properties, resulting in parts that do not meet the necessary performance standards.

Post-Processing Requirements

True silicone parts often require extensive post-processing to achieve the desired surface finish and mechanical properties. This additional step can introduce variability into the manufacturing process, affecting consistency and increasing production times.

The LumiaX1 Breakthrough in Manufacturing True Silicone

The new solution debuts with a special formulation, TrueSil-X50, a biocompatible, 100% pure silicone material offering exceptional performance and versatility for both industrial and healthcare applications. This milestone qualification enables customers to additively manufacture high-quality silicone parts with high precision and surface finish.

This material combines low viscosity, durable mechanical properties, and high resolution. Although typically challenging to print with photopolymerization, when 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 parts ideal for end-use applications. From microparts to ultra-thin walls and complex geometries, it's the perfect choice for demanding applications.

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.

Key Features of TrueSil-X50

A special formulation made exclusively for the LumiaX1 contains 100% pure silicone with no additives. The material ensures optimal performance and durability, particularly through its resistance to harsh environmental influences. It offers several key advantages, including low viscosity, which enhances printability for intricate designs and micro-details. Its high resolution enables precise geometries and sharp edges, while exceptional surface quality produces smooth finishes directly from the printer. Additionally, its biocompatibility makes it safe for medical, cosmetic, and wearable applications. This silicone material offers design freedom, excellent mechanical performance, and time and cost savings. Its durability and biocompatibility make it invaluable across healthcare and industrial sectors, facilitating the creation of safe, long-lasting medical devices and high-performance industrial components. This material excels in adaptability to extreme conditions, bridging the gap between safety and performance.

TruSil-X50

48A
Shore Durometer

330%
Elongation At Break

6.3MPa
Tensile Strength

0.74MPa
Young Modulus

22N/mm
Tear Strength

55%
Rebound Resilience

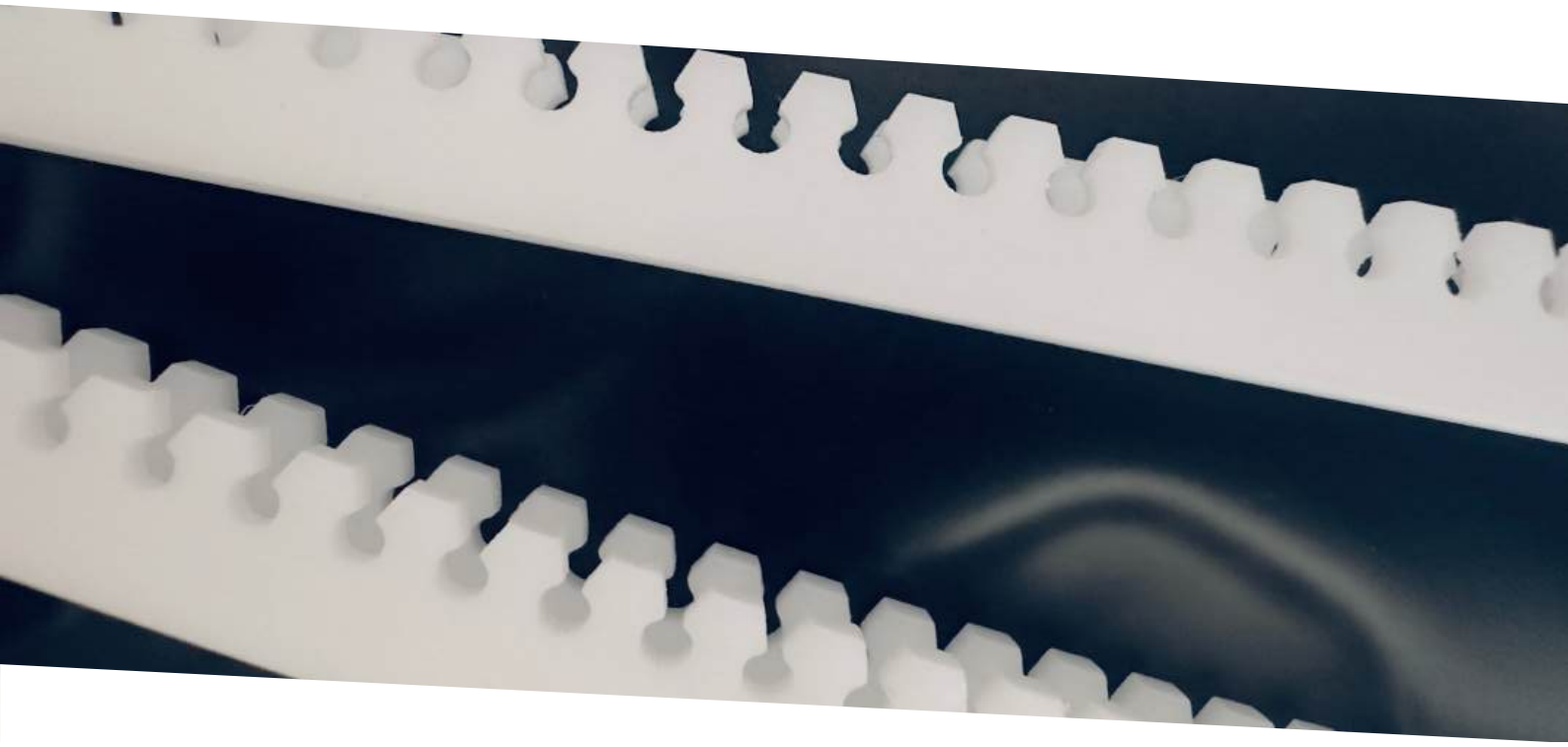
Versatility Across Multiple Verticals & Applications

Industrial

TrueSil-X50 offers exceptional utility across a broad range of industrial applications.

Sealants, Gaskets, Grommets, Buttons Keypads

It enhances sealants, gaskets, and grommets with excellent surface quality, while silicone buttons, keypads, and input solutions provide a highly cost-effective choice for HMI applications. TrueSil-X50 supports top-tier sanitary solutions,



Microparts

This material is also mission-critical for silicone microparts, which are essential in medical products, household appliances, food and beverage processing, and electrical engineering.

Adapters and Holders

Additionally, adapters and holders made with TrueSil-X50 deliver a reliable fit due its accuracy and feature resolution.

Electrical Connectors

TruSil-X5- properties as an electrical insulator and waterproofing material enhance the performance of electrical connectors. These connectors protect and connect electrical parts used in automotive and many other electrical applications.

Bellow and Suction Cups

TrueSil-X50 bellows ensure flexible, airtight protection for moving parts, and silicone suction cups improve efficiency in pick-and-place automation.

Silicone Grippers

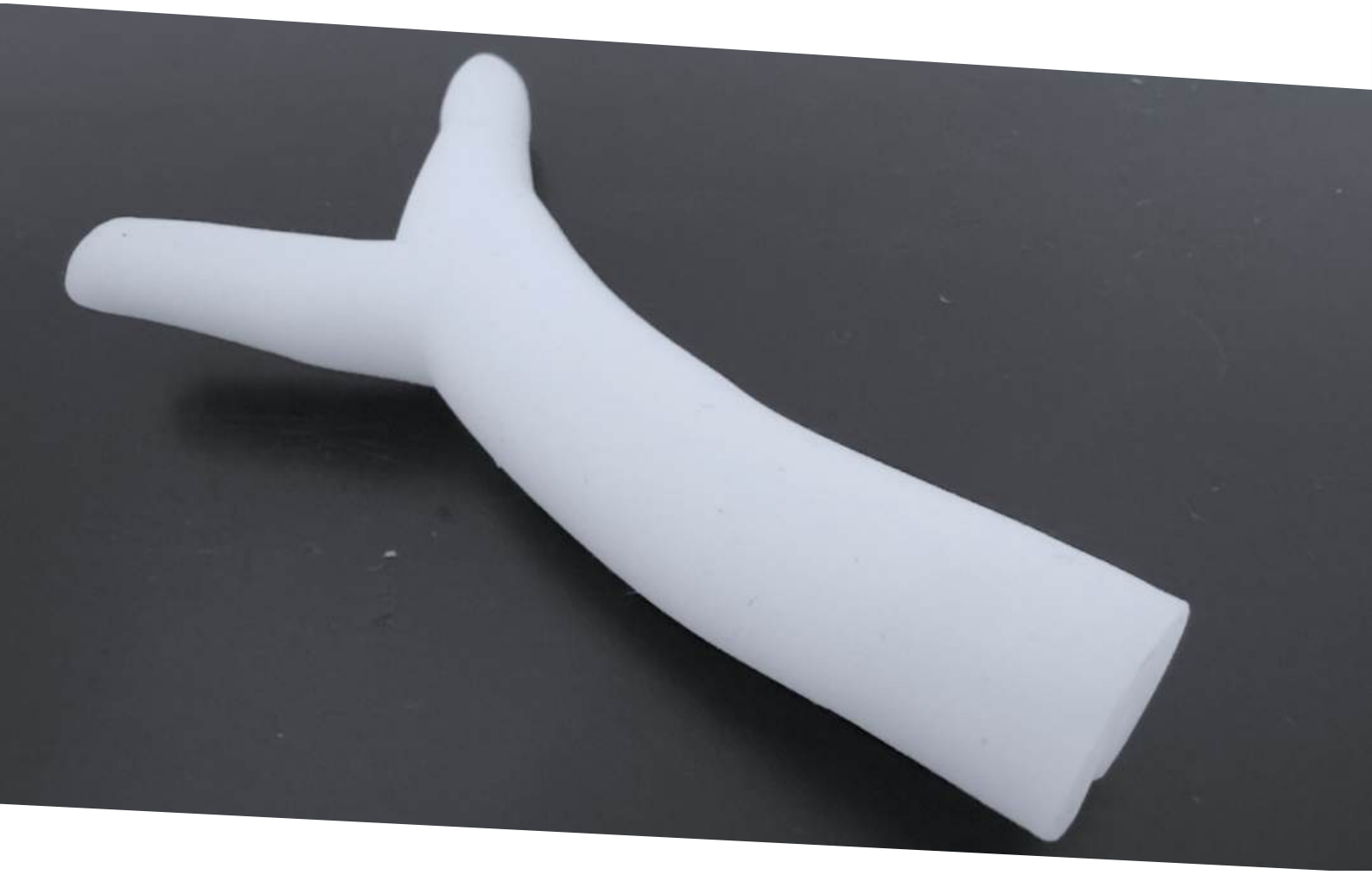
TrueSil-X50 also enables the production of complex parts for serial manufacturing in automation and robotics, like grippers, allowing designs beyond traditional injection molding limits. Custom grippers for food and beverage, cosmetics, and pharmaceuticals automation. Soft grippers easily handle a wide array of irregular shapes and delicate objects.

Healthcare

TrueSil-X50's flexibility makes it an ideal material for healthcare applications. Here are the ones that benefit most from its properties and value.

Anatomical Models

Its unique tissue-mimicking properties allow for precise replication of vascular and organ models, capturing the feel and function of both healthy and diseased tissue.



Wearables and SmartWear

This is applicable where customization is key, or low volume production is needed for improved performance.

Implants

TrueSil-X50 improves comfort and performance, and for patient-specific implants, it offers complete customization tailored to individual needs.

Audiology

In audiology, TrueSil-X50 enables the creation of custom-fit headphones and ear tips, hearing protection devices with superior sound insulation, and hearing aids with reduced lead times and costs.

Dental Mouthguards

The dental industry benefits from TrueSil-X50's versatility, making it ideal for producing mouth guards that protect against teeth grinding and sports injuries, as well as positioners to align occlusion at the conclusion of orthodontic treatments.

Cosmetic Applicators & Baby Care Products

For cosmetics and baby care to female care products, its biocompatibility and feature resolution opens a new design space to respond to the latest trends for cosmetic applicators like mascara brushes or lipsticks. A lean on-demand low volume production setup is possible.

Summary

TrueSil-X50 marks the beginning of Axtra3D's journey into silicone printing, unlocking new opportunities for product innovation across industries. With its HPS technology, Axtra3D's printers offer customers unparalleled print freedom and material flexibility, making high-performance silicone parts accessible like never before.

Axtra3D

Based in the US and Italy, Axtra3D is a global company specializing in Hi-Speed SLA systems that eliminates tradeoffs between print throughput, accuracy, feature resolution, and surface finish, typically found in traditional SLA or DLP systems.

The flagship Lumia X1 Hi-Speed SLA system by Axtra3D represents a significant advancement, combining its Hybrid PhotoSynthesis resin polymerization process with TruLayer, a layer separation technology. HPS utilizes both a laser and a DLP to image simultaneously, while TruLayer enables rapid detachment of the active print layer, resulting in a 20X throughput improvement while preserving the accuracy and fidelity of SLA parts.
With a curated material portfolio, Axtra3D has developed over 15 certified solutions for industries such as Industrial, Healthcare, and Dental, serving a global customer base. These solutions range from direct-use ceramic molds to end-use electrical connectors, industrial parts, dental prosthetics, medical devices, jewelry patterns, and more. Axtra3D's systems are available in North America, the EU, and Japan, and a broad range of customers have already benefitted from its diverse range of applications.

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