Technical Note

Dimensional Accuracy of Printed Parts on LC Titan

Introduction

Dimensional accuracy is a critical performance metric for any additive manufacturing platform. This Technical Note outlines the factors that influence the accuracy, precision, and repeatability of parts printed on the LC Titan. It also details how LC Titan hardware, materials, and workflow contribute to consistent performance across the build volume.

The purpose is to equip our technical users with practical insights to achieve optimal results with LC Titan in demanding manufacturing environments.

Definitions

Understanding key definitions helps in evaluating the performance of additive manufacturing processes:

Accuracy

Accuracy is how close a measurement is to true value, which is derived from comparing the measured value from a Titan part to the dimensions designed in CAD.

Precision

Precision is the repeatability of a measurement, which means how much you can rely on Titan to produce your expected results, every time.

Tolerance

Tolerance is how precise the critical elements of a part need to be, generally, achieving tighter tolerances means higher manufacturing costs, Titan's pixel pitch is a factor in determining this.

Choosing the Right Manufacturing Process

Evaluate the suitability of your manufacturing technique based on meeting the necessary part tolerances. Assess whether its typical tolerance range aligns with your part's requirements:

Tolerance	Suitable Manufacturing Processes
Fine or Precision	CNC Grinding, Precision CNC Machining (Milling & Turning), Electrical Discharge Machining (EDM), SLA, and LC Titan
Medium or General Engineering	CNC Machining, Die Casting, Injection Moulding (standard tooling), Powder Metallurgy (with secondary machining) and FDM
Coarse	Sand Casting, Forging, Stamping and Pressing, Welding & Fabrication, Low-resolution 3D Printing, Manual Machining with digital control.

Tolerances in 3D Printing

In traditional machining, tighter tolerances are exponentially related to increased cost. Tighter tolerances require additional and slower machining steps than wider tolerances, so machined parts are designed with the widest tolerances allowable for a given application.

Unlike machining, 3D printing has a single automated production step. Tighter 3D printing tolerances may require more effort in the design stage, but can yield significant savings in time and costs in prototyping and production.

3D printing with resin (stereolithographic printing) by laser, DLP or LCD systems and powder bed fusion 3D printing (SLS and MJF) have the highest tolerances of commercially available plastic 3D printing technologies. Compared to machined accuracies, resin and powder 3D printing tolerances fall between standard machining and fine machining tolerances.

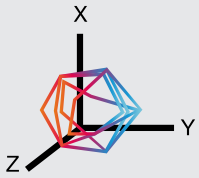
LC Titan System Overview

LC Titan as an LCD 3D platform will deliver accurate, precise and consistent parts if you understand how to use it correctly and adopt the recommended digital file modification.

LC Titan uses an 8K LCD screen with a 91µm pixel pitch across a 695mm × 385mm build area. Key accuracy enablers include:

Fixed high-resolution LCD light mask

Maintains constant curing profile over time without loss of focus or alignment. This ensures reliability along the x:y plane.



Z-axis mechanics and accuracy

A highly engineered linear drive and control system ensures reliable and precise vertical movement and dimensional stability throughout the full build height.

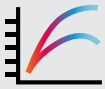
Uniform 460nm polymerisation

Delivers consistent and repeatable cure through depth, across the build area and across different LC Titan printers.

Together, these ensure both dimensional reliability and cross-printers repeatability.

Accuracy Considerations

Achieving consistent dimensional accuracy in additive manufacturing requires more than just capable hardware. It depends on understanding how geometry, materials, orientation, and post-processing interact throughout the print workflow. This section outlines key factors that influence accuracy on the LC Titan and provides practical guidance for optimising results across different part types and use cases.



Critical Features First

For any given geometry, start by identifying the critical features that impact function or assembly. Define the necessary tolerances for these key dimensions and prioritise them throughout the manufacturing process.

Factors Affecting Accuracy

Material and part geometry will always influence achievable tolerances. Post-processing (polishing, machining after casting/printing) can tighten tolerances. Cost and time typically increase with tighter tolerances.

Part Design & Preparation

Designing parts specifically for large-format LCD additive manufacturing is essential for successful printing. Proper orientation, support strategy, and geometry design—especially for thin and tall (high aspect ratio) features—are key to reducing warpage and ensuring structural stability during the build.

If possible, orient parts to have gradual surface increase to avoid warpage. This will help to manage shrinkage effect and also improve reliably by managing peel forces. This helps manage peel forces and improves overall print reliability.

Our Aftersales team offers expert design support and consultancy. We can advise on part orientation, support placement, and how to optimise your geometry for the LC Titan. Different types of geometry require different approaches, and we're here to help you apply the best practices for your specific application.

Material Selection

Choosing an optimal resin involves balancing the mechanical performance of the final part with the green strength (modulus before post-curing) needed during printing. This is especially important on bottom-up LCD systems such as LC Titan, and requires managing the weight of parts against gravity. While rapid double bond conversion improves end-use properties, it can make printing more demanding.

Photocentric's resin range is formulated for high dimensional accuracy, fine detail, and minimal warpage. These resins are ideal for parts that must hold their shape under stress or heat. Photocentric rigid range like Hard Black and HighTemp DL401 offers the best accuracy our most accurate resin, offering excellent green strength and low shrinkage - perfect for large or intricate parts. Other resins in the range provide different balances of stiffness, surface finish, and durability to suit a variety of applications.

All Photocentric resins are supported by tailored print profiles with optimised exposure settings to ensure consistent, high-quality results.

Post-Processing

LC Titan is available as part of a comprehensive eco-system that can include a transfer unit, Wash XL and Cure XL units. This end-to-end solution enables the parts to maintain isotropy by being washed and post exposed on the platform.

Our Wash XL solution is designed to remove excess of resin while not reducing mechanical integrity. The combination of heat and double wavelength light provided by our Cure XL ensures parts fully cure, whilst constant rotation ensures that curing is delivered evenly to all sides, reducing the possibility of warping.

Finishing

Finishing steps for 3D printed parts assemblies commonly include de-supporting, sanding support artefacts and spray painting. Sanding an active surface is a reasonable method for achieving the correct fit if the part is a one-off, because less tolerancing work is required in the design phase, but with larger assemblies, or when producing multiples of something, proper dimensional tolerancing by iteration is essential.

Validation by Iteration

Once a manufacturing technique has been selected, parts should be produced from at least three separate batches to validate production consistency. As part of this process, critical dimensions should be measured to determine the average and deviation from nominal values.

Based on these results, the CAD model should/may be adjusted to reflect the observed averages, and a second round of manufacturing (again with at least three parts) should then be carried out to verify consistency and repeatability.

LC Titan Accuracy Testing

To validate the LC Titan's performance, we conduct controlled accuracy and repeatability tests that simulate real-world production conditions. These tests measure dimensional deviation across the build volume and assess consistency over multiple runs, providing objective benchmarks for what users can expect when the printer is correctly configured and operated.

Full build volume test

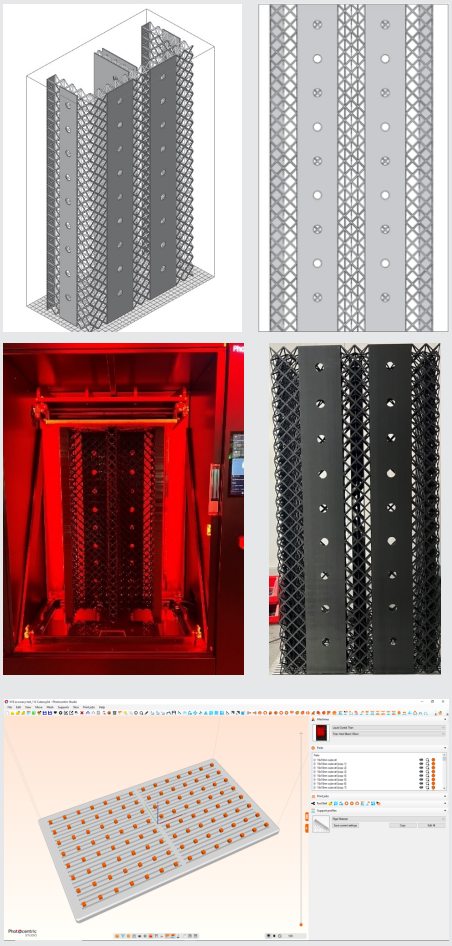
We set up a full 1.2m high test print and then measure all the elements of the part, relative to each other.

Measure Build volume accuracy

You will be able to achieve within +/- 0.10% volumetric accuracy in printed parts compared to CAD if you are prepared to make a few of the items; more typically +/- 0.20% volumetric accuracy is readily achieved with a well-supported part.

Ensure Build volume repeatability

To test repeatability, we set a file up with 112 cubes (10x10x10mm) distributed evenly across the platform and print them at 100µm layer thickness. With repeated processing, measuring and comparing the cubes, we can determine that the x:y tolerance across the build is within +/- 100µm.



Conclusion

The LC Titan delivers high levels of dimensional accuracy, repeatability, and process reliability. By understanding the relationship between part design, material properties, post-processing, and LC Titan's hardware capabilities, technical users can confidently achieve tolerances suitable for demanding prototyping and production applications.

For further support or more application specific recommendations, our support team is available to provide assistance.