O'Fallon Casting Inc.

increases prototyping speed and quality using Cross Scanner and PolyWorks software

O'Fallon Casting in St. Louis, Missouri USA took a new approach by installing a Cross Scanner from Nikon Metrology and PolyWorks software from InnovMetric Inc. A prototyping project illustrating the innovation of 3D scanning and point cloud based inspection involved the housing for an integrated wing tip light of the Boeing 787 Dreamliner. O'Fallon engineers inspected both the housing's foam pattern and inherent aluminum part, and managed to cut the entire process throughput time by 50%. The countless measurement points acquired and the CAD comparison analysis graphics enabled them to better supervise the process, eliminate prototype rounds and deliver top quality.

Cross Scanner @ O'Fallon Casting (USA)

The Cross Scanner digitized a housing prototype of an integrated Boeing 787 Dreamliner wing tip part. The point cloud data of the housing's foam pattern and inherent aluminum part were fed into PolyWorks for further processing.

- Process cuts throughput time by 50%, reducing turnaround time for customer
- Detailed scans and graphic analysis improve quality and eliminate prototype rounds
- Reduced tooling cost through fast and accurate prototype verification

Rapid prototyping of cast parts is good business

O'Fallon Casting of St. Louis, Missouri, is a premier nonferrous investment casting company that has built its reputation on making high-quality, competitively priced castings to meet demanding end-user applications. In its 50,000 square-foot facility, the company is specialized in casting a range of aluminum, metal and composite alloys, and serves a broad range of markets.

Prototyping the housing for an integrated wing tip light of the Boeing 787 Dreamliner

One area of growth for the company has been in its rapid prototyping operation. It uses expendable patterns generated from a 3D model from a CAD file to quickly and cost effectively produce a part and verify its design prior to building production tooling. "In recent years, there have been many improvements in the quality of pattern surface finishes, pattern accuracy, and pattern material alternatives, and today's patterns are more user friendly to the near net shapes offered by the investment casting process," said Ben Galmiche, O'Fallon Casting quality engineer. Because of these improvements, rapid prototyping of cast parts is good value for customers who want to reduce overall tooling costs and introduce products into the marketplace quickly. Quality inspection is a crucial aspect of the casting business.

Part inspection with Ben Galmiche (left) and Ted Schnarre (right) from O'Fallon Casting Inc.

Charged with increasingly complex freeform part surfaces

"In the past, we did not have an effective and efficient way of inspecting solid models. We had an old cantilever-type coordinate measuring machine (CMMs) and used a touch trigger probe to collect dimensional data. This process was slow and we were looking for a new alternative." For decades, the use of traditional touch probes on CMMs has been the gold standard. However, the time-consuming process becomes an even bigger drain on a quality department's valuable resources. Metrology engineers are charged with increasingly complex freeform part surfaces that take an exceptionally longer time to thoroughly inspect.

To help enhance the turnaround time of its rapid prototype inspection process, O'Fallon Casting turned to 3D scanning and point-cloud-based inspection. O'Fallon Casting replaced the older CMM and equipped it with a Nikon Metrology Cross Scanner, a high-speed, multi-stripe 3D laser scanner designed for inspecting part features that provides optimal point distribution in all directions. This new 3D measurement system was delivered with the PolyWorks software suite from InnovMetric Software Inc.

> *"The Cross Scanner offers the tremendous advantage of gathering complete data sets, better than what we have ever been able to accomplish through tactile inspection.*
>
> *Ben Galmiche, Quality Engineer for O'Fallon Casting*

Turbo charging a CMM with 3D laser scanning

This investment proved to be the right move, one that paid off quickly. Particularly when O'Fallon Casting received a request to inspect the housing for an integrated wing tip light of the Boeing 787 Dreamliner.

Here is how O'Fallon successfully integrated the point cloud based analysis in all phases of its rapid-prototyping process:

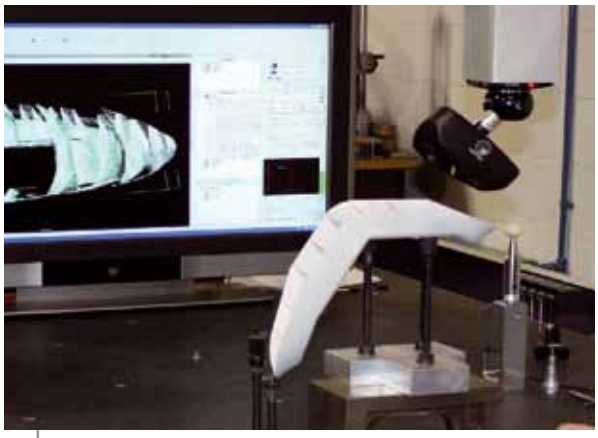
- A pattern of the wing tip light housing was created from the customer's 3D CAD model of the part using stereolithography (SLA) and selective laser sintering (SLS).
- The pattern was then visually and manually inspected to determine if it conformed to the reference CAD model of the part and if it was properly proportioned to account for shrinkage.
- Once the pattern was verified and approved through Nikon Metrology 3D scanning and PolyWorks inspection, O'Fallon Casting built a ceramic shell around the rapid prototype pattern.
- The ceramic shell with the pattern went through a burn out process, where the pattern was vaporized to leave only the ceramic mold. The part was cast from A356 aluminum artificially aged to the T6 condition.
- The part was then measured using the Global CMM and the laser scanner. The point cloud data gathered during this routine was transferred to the PolyWorks software electronically via the company's internal network.

In the overall process, O'Fallon Casting used 3D digitizing and PolyWorks to inspect both the foam pattern and its inherent aluminum part. In the scan process, excess data is collected to capture freeform surfaces and accurately characterize 3D features. As the Nikon Metrology scanner sweeps lasers in 3 directions, the entire geometry of features is captured consistently, regardless of the scanning direction. This allows PolyWorks software to extract features through hundreds of points, rather that relying on a handful of tactile inspection points. Simplified scanner motion paths also means more straightforward off-line CMM programming.

"The Cross Scanner and Focus Inspection software from Nikon Metrology is a powerful package," marked Galmiche. "In less than one week we were up and running to use 3D scanning in real customer projects. The non-contact scanning solution offers the tremendous advantage of gathering complete data sets, better than what we have ever been able to accomplish through tactile inspection. Likewise, we now perform a laser scanning job in less than a day whereas it previously took us nearly one week. We have reached the point where laser scanning is used in virtually all our rapid prototyping projects, paying off big time both for inspection and troubleshooting purposes."

Example of an integrated wing tip light

Boeing 787 Dreamliner © Boeing



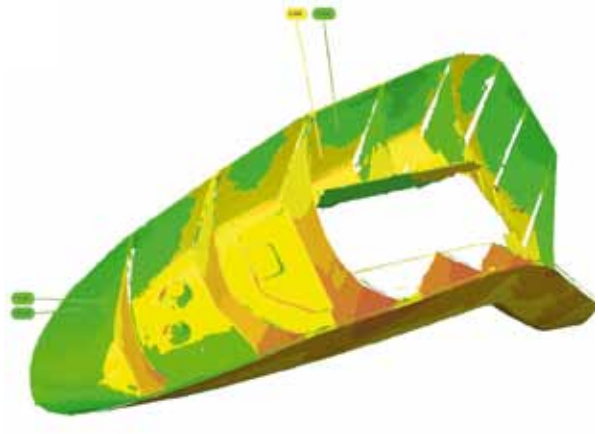
Nikon Metrology's Cross Scanner acquired the entire geometry of the wing tip light housing.

Example of an integrated wing tip light

Powerful point cloud processing and graphic geometry analysis

PolyWorks software's IMAlign™ module was used to align partial scans, verify surface coverage and remove scan overlap data in creating a single set of data points. Next, the aligned scans were merged using the IMMerge™ module to create a highly accurate finely detailed polygonal mesh model of the digitized parts.

The polygonal mesh model was then exported to PolyWorks IMInspect™ module for the actual dimensional inspection process. For this specific project, a global comparison was performed by calculating the deviation between each digitized point and its corresponding CAD reference. A color map was displayed according to the tolerances set by O'Fallon Casting. O'Fallon Casting engineers measured the clearance of the part by comparing 3D distances between two planes to ensure that the ray of light is projected without interference.



A color map showing the global comparison between the digitized points and their CAD reference.

Gaining deeper insight through graphic geometry analysis

"In addition to the data, we include snapshots of the model comparison so that customers can quickly see where the part is out of tolerance," Galmiche said. "We can also illustrate where the part is just a small amount out of tolerance or greatly so by using different colors to indicate different tolerance ranges. Finally, thanks to the PolyWorks IMView free viewer software, our customers can visualize their inspection projects in 3D from their own workstations."

Wall thickness, clearance, 3D angle and flatness analyses are performed using PolyWorks IMInspect