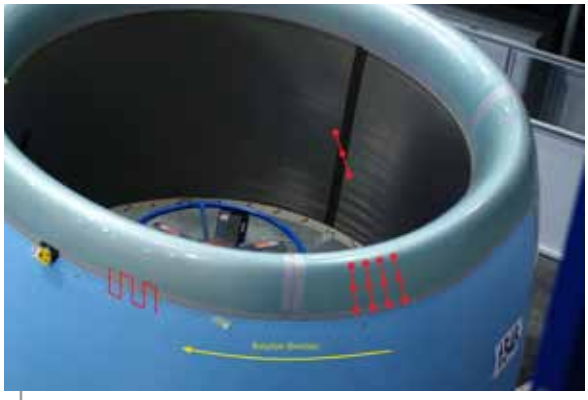
Airbus automates A340/350/380 composite nose cowl inspection using Nikon Metrology Laser Radar

Every micron counts when high in the sky, massive airflows are sucked into the jet engine inlets. The size and sophistication of composite jet engine inlet cowls for Airbus A340/350/380 aircraft call for a dedicated metrology approach. To inspect inlet cowl form and assembly, Airbus opted for a Laser Radar inspection cell that turns around inspection in a fast and automated fashion. Inlet cowl measurements are needed to detect deformations or assembly faults causing aerodynamic disturbances that potentially induce excess vibration or increase fuel consumption. According to Airbus, the Laser Radar illustrates how an integrated metrology solution offers automated targetless inspection and smooth production floor operation.

Nantes' leadership in composite part manufacturing

Airbus' Nantes site in France is a leader in the manufacture of composite structural parts, such as the nacelle air inlet cowls for the engines of A340-500/600, A350 and A380. Composite materials have gained popularity in high-performance structures that need to be lightweight, yet strong enough to take harsh loading conditions. The inner side of a nacelle air inlet is made of nature composite material and the leading edge is made of aluminum. Inlet cowls are designed for low weight and minimum aerodynamic resistance to help increase aircraft mileage.

The nacelle inlet cowl is riveted and glued to the main jet engine body in Nantes. "To speed up inspection, Airbus was looking for a metrology system that is accurate and fast enough to measure the large nacelle air inlet assemblies more productively," explains Thierry Pavageau, responsible for the integration project at Airbus Nantes and currently Equipment Maintenance Manager A350 Unit. The assembly of different body components and engine takes place in a dedicated factory wherefrom the complete engines are sent to the final assembly line in Toulouse. The aero engines themselves are manufactured by Engine Alliance (CFMI, Pratt&Whitney) or Rolls-Royce, depending on the engine model and type.



Laser Radar executes automatic freeform surface and gap & step measurements at every increment of the rotating nose cowl.

Airbus opted for an automated Laser Radar inspection cell that drastically speeds up nose cowl inspection.

Metrology search ultimately led to Laser Radar

The Laser Radar measures the freeform internal and external cowl surfaces as well as the precise gap and step between the leading edge and the mentioned surfaces. "We analyze the acquired data to ensure high-quality assembly and part mating. From an efficiency standpoint, it was important for us that the entire process from measurement to final report could be executed automatically with just a single mouse click."

When looking for a suitable measurement solution, traditional CMMs were eliminated as the inspection of composite materials preferably were measured using a non-contact technique. Also the necessary foundation on the shop floor and part loading system for a gantry CMM suitable for measuring objects of this size is an very costly.

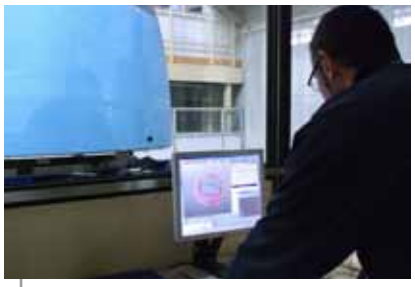
At the time when system was selected, the use of 3D laser trackers was also not an option for an automated application. 3D Trackers required an operator to manually hold a spherically mounted retroreflector (SMR) or a handheld probe. Human interaction slows down the inspection process, and is too error prone to comply with Airbus' extreme safety precautions. Also photogrammetry was investigated, and although interesting for surface inspection, this measurement technology did not provide an appropriate solution for gap & step measurement. Finally, Airbus opted for the integration of a Laser Radar system, which combines automated non-contact laser measurement, surface and feature scanning capability and a dedicated gap&step analysis function.

Completely automated operation

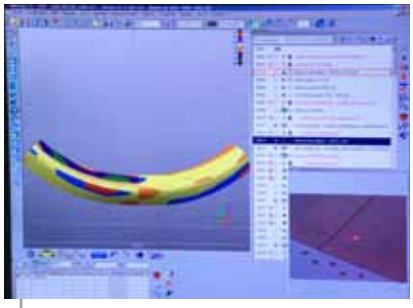
Nikon Metrology teamed with Metrolog and Spatial Analyzer to deliver an automated inspection solution with fast throughput cycles. In the integrated inspection cell in the Airbus assembly hall, the Laser Radar system is mounted on a post up in the air, in a fixed tilted position using a custom-designed frame. A technician operates a large gantry crane to correctly position a nose cowl assembly on a large rotating table on the production floor, ready for inspection.

"A single click on a button starts the automatic measurement and analysis procedure," explains Thierry Pavageau. "The Laser Radar instrument references the rotating table by measuring small tooling balls. The Metrolog software controls the rotation increments of the part and the acquisition of Laser Radar data. During a single revolution, the Laser Radar measures over 1,000 surface points to capture the 3D geometry of the leading edge. The inspection cycle also covers scanning 250 gap and step positions to evaluate part mating between leading edge and inlet body. Other measurements involve the anti-ice interface, which can be accessed by the Laser Radar using a mirror." When directing a focused laser beam to a point, the Laser Radar only requires a billionth of the reflected light to exactly measure the absolute range to the point, with 250 micron accuracy over a 25 meter distance.

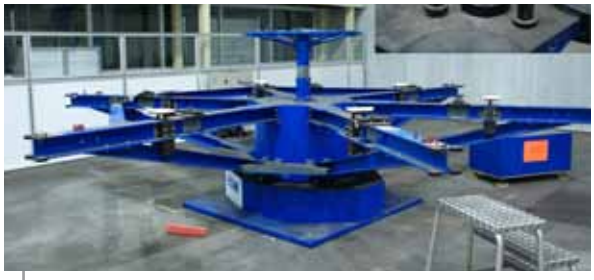
Pavageau says that all results are instantly processed and summarized in an easy-to-interpret report. "Color-coded areas on part-to-CAD comparison charts graphically illustrate the geometric deviation of the leading edge and other surfaces. The operator



The Metrolog software synchronizes the rotation of the Airbus nose cowl with the Laser Radar measurements.



The color-coded areas graphically illustrate the geometric deviation of the leading edge surface.



The huge rotating table is equipped with small tooling balls the Laser Radar measures to reference the table.

Detail of tooling ball on rotating table

verifies out-of-spec tolerances, and in case of anomalies informs the quality department for further investigation."

Laser Radar slashes inspection time and operator overhead

Airbus is satisfied that the complete inspection cycle from nose cowl positioning to graphic report is completed in only 90 minutes. "The optimization of the automatic inspection cell saves us two and a half hours inspection time for every A340/350/380 nose cowl assembly that passes through the cell," concludes Pavageau. "This means a 60% productivity increase in comparison with the old station. Important in streamlining this process was the introduction of the Laser Radar instrument and the enhanced calculation algorithm for gap & step measurement. Furthermore, no operator action is required whatsoever because the Laser Radar system eliminates the use of photogrammetry targets, retro-reflectors or handheld probes." The Laser Radar inspection cell was originally deployed for inspection of A340 /A380 engines cowls and has recently been approved for inspection of A350 engines.

About Nikon Metrology

Nikon Metrology, part of the Nikon Corporation offers the broadest range of metrology solutions for applications ranging from miniature electronics to the largest aircrafts. Nikon Metrology's innovative measuring and precision instruments contribute to a high performance design-through-manufacturing process that allows manufacturers to deliver premium quality products in a shorter time. Further information is available on www.nikonmetrology.com

For further information please contact:

Renaat Van Cauter
Director Marketing Communications
Nikon Metrology NV
Geldenaaksebaan 329
B3001 Leuven, Belgium
renaat.vancauter@nikonmetrology.com
Tel +32 16 74 01 00