



Subcontractor upgrades metrology department and offers service to other manufacturers



Nisan Engineering installs new ALTERA CMM and retrofits Mitutoyo machine with CMM-Manager software

Dinesh Prajapati, a director of Leicester-based subcontract machinists, Nisan Engineering (www.nisanengineering.co.uk), takes the view that there is no point machining a component if you cannot check that it is within tolerance. The problem was that parts were becoming increasingly difficult to inspect after the company, which traditionally used 3-axis CNC machining centres, installed a 4-axis horizontal-spindle model in 2013 and a 5-axis vertical machining centre in August last year.

Much more complicated components were being produced on these machines and some of the features were impossible to inspect on the company's manual coordinate measuring machine (CMM), which dates back to the 1990s. If the features were critical and could not be inspected by hand using other conventional metrology equipment, work had to be turned away, as in most instances there would not have been time to send the parts out for checking.

Purchase of an ALTERA 8.7.6 CNC CMM from Nikon Metrology (www.nikonmetrology.com) in early 2015 provided the solution. It is able to inspect the most complex parts that Nisan produces and in addition, all parts are measured in a fraction of the time that was previously needed on the manual machine.

While the new CMM was being installed, Nikon Metrology retrofitted identical control software, called CMM-Manager, to the manual Mitutoyo BH504 CMM. It considerably increased the speed with which components can be inspected on what was rapidly becoming an outmoded facility, giving it a new lease of life.

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Mr Prajapati, director of Leicester-based subcontract machinists, Nisan Engineering



The aluminium turbine component being inspected in a cycle time of 10 minutes at Nisan Engineering, Leicester.

Mr Prajapati gave a couple examples of the significant benefits obtained using the new CMM and the upgraded machine. The first refers to a part produced on the 5-axis machining centre that could not previously be inspected at all, whereas it is an easy process on the ALTERA. The second concerns a 4-axis machined component that is now inspected more comprehensively and faster on the new CMM as well as on the Mitutoyo with Nikon Metrology software.

5-axis machining productivity maintained

The 5-axis job is an aluminium housing measuring 172 mm in diameter by 52 mm high that forms part of a turbine used for renewable energy generation. After CNC turning of the bore and outside diameter (OD), the part goes onto a German-built Spinner 5-axis VMC for a substantial amount of milling and cross-drilling at various oblique angles. One hole is at 30 degrees, another at 45 degrees and a third at 52 degrees. All are of 0.8 mm diameter and intersect at a point.

These holes could not practically be measured on the manual CMM, even with the new software, whereas it is an easy process on the ALTERA using a very fine touch probe in the Renishaw PH10T motorised indexing head. The entire part is checked in two automatic cycles taking a total of 10 minutes, including automatic probe exchange, during which time the operator is free to do other tasks. Tightest tolerance is 10 microns total on the OD and bore.

Mr Prajapati said, "Repeatedly repositioning the head by hand on the manual CMM takes half an hour each time. Doing this three times to inspect the holes plus several more times to access other features would take five or six hours, far too long to be a viable method of inspecting the turbine component. Additionally, it would

risk introducing inaccuracies.

"The 5-axis machine would be waiting for over half a shift for the first-off inspection to be completed, wasting an expensive machining resource. Then for example if a drill breaks during production and needs to be replaced, rechecking those machined features would hold up production, further raising the cost per part of manufacture."

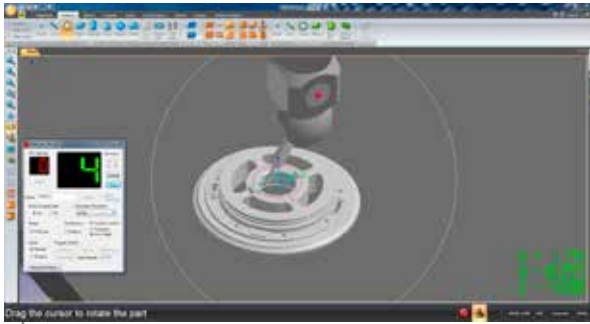
Comparison of CNC and manual inspection

Examining the measurement of a family of EN8 steel components that have been produced in the Leicester factory for the past two and a half years on an Akari twin-pallet, 4-axis HMC sheds light on the significant advantages of retrofitting Nikon Metrology's CMM-Manager software to the manual Mitutoyo.

The gas flow meter cylinders are machined in 10 sizes from solid billets measuring from 74.5 to 145 mm in diameter and 270 to 557 mm long. A bore of between 34 and 65 mm diameter is machined during the first operation, followed by drilling, tapping and milling around the periphery during op 2. Bores have to be accurate to 37 microns total and other dimensions to between ± 0.1 and ± 0.2 mm, while the faces of the component are tied up to the bore to within 50 microns concentricity and parallelism.

Using the manual CMM and pre-existing Mitutoyo software, inspection took 40 minutes. It was followed by conventional hand-gauging of a threaded hole and manual inspection of certain other inter-related positional features that could not be included in the CMM procedure, which added a further 10 minutes.

With the ALTERA CMM the same process takes just 9 minutes - less than one-fifth of the time - and extra measurements are taken,



Turbine component inspection



resulting in a more comprehensive inspection. The cycle has to be programmed the first time, but on all subsequent occasions it is available for immediate reuse.

On the BH504, the new Nikon Metrology software enables the measurement of all features, according to Mr Prajapati. It cuts the original inspection time by around 20 per cent and eliminates manual intervention, so over a quarter of an hour is saved. With the previous software, it was necessary to type in code and repeatedly change the projection, whereas CMM-Manager is intuitive and completes these tasks automatically, saving even more time.

Moreover, the identical program from the ALTERA can be loaded into the CMM-Manager software on the Mitutoyo CMM so that the operator can follow the same cycle to complete the inspection. On-screen component images and fixturing instructions speed set-up, while live reporting shows actual sizes measured versus the nominal.

Mr Prajapati confirmed, "Nikon Metrology completed our Mitutoyo CMM software retrofit first, and provided initial training, which allowed me to familiarise myself with its capabilities before starting to use the CNC machine.

"I was measuring components on the Mitutoyo within half a day of the software training. Apart from the speed of operation, the other significant benefit is the comprehensive reporting that is possible.

"It shows immediately if a feature is within tolerance or not, while results are collected and presented in graphical or tabular form and can be stored on a hard drive and emailed to the customer. Previously, reporting was restricted to simple printouts and involved up to half an hour's typing if it was a complex component."

Nisan's inspection procedures at Leicester

Over half of the ISO 9002-registered subcontractor's turnover comes from the oil and gas industry. The remaining contracts are derived mainly from the food, rail and marine sectors and more medical work is being sought since the arrival of the 5-axis machine. Batch quantity ranges from one-off prototypes to 1,000-off.

The first-off part is always sent to the metrology department. Then, depending on the size of the run, component complexity and drawing tolerances, every 10th component is typically checked on one of the CMMs. A random sample from the end of the batch is also fully inspected.

This core metrology regime is assisted by periodic on-machine measurements of key features by operators using conventional measuring methods. Extensive use is also made of on-machine probing to check datums and detect tooling errors. For example, the turbine component has three features probed on the Spinner and the flow meter cylinders have 10 features examined.

Programs are created via different routes. If a CAD model exists, as it did for the aluminium turbine part, the data is entered into CMM-Manager and the inspection routine is produced directly from it. If only a drawing is available, as in the case of the flow meter cylinders, a graphic of the part is built up and a measuring cycle created by manually moving the probe to the relevant inspection points on the CMM.

The deciding factors

Five CMM suppliers were reviewed by Nisan before the purchasing decision was made. Mr Prajapati said that a key point in favour of Nikon Metrology was that no other supplier, apart from Mitutoyo themselves, was prepared to retrofit new control software to the BH504. It was also noted that the original manufacturer's software was not so user-friendly.

He recalled, "All five potential CNC CMM providers carried out measuring trials on one of the flow meter cylinders. Cycle times were broadly similar.

"However, we preferred the build quality of the ALTERA as well as the control software's ease of use.

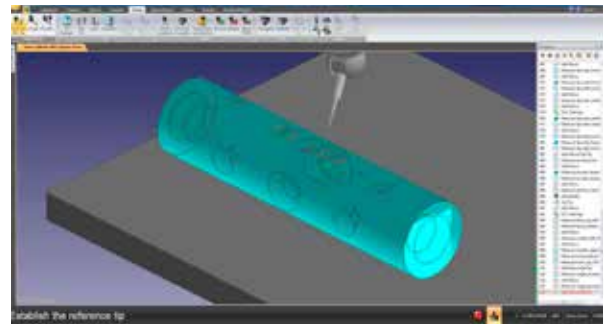
"The fact that the machine is built in nearby Donington was an added bonus, as was the 10-year accuracy warranty and the supplier's willingness to offer a Renishaw probe, which some others were not."



The same cylinder being inspected on the manual Mitutoyo CMM, retrofitted with CMM-Manager software.



One of the EN8 gas flow meter cylinders, measuring 130 mm in diameter by 550 mm long, being inspected in a 9-minute cycle.



Gas flow meter cylinder on the control screen of the Altera 8.7.6 CMM.

Subcontract inspection service

When Nisan formulated its plan to modernise the metrology department at Leicester, it decided to invest in the construction of a temperature-controlled inspection room in addition to the Nikon Metrology CMM and extra software at a total cost of £70,000.

By this Autumn (2015), when all programs have been created for existing repeat jobs and the department is fully operational, Mr Prajapati predicts that only half of the resource will be needed for internal inspection, based on the current single day shift. He therefore intends to offer metrology services to other manufacturers.

The facility will be available first to Nisan's customers and then to other subcontractors and OEMs in the area. Interest has already been expressed by several companies.

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