

Subcontractor upgrades metrology department and offers service to other manufacturers

UK subcontract machinists Nisan Engineering purchased an LK ALTERA CMM to inspect more complex parts



While the new CMM was being installed, identical software was retrofitted to a 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.



Repeatedly repositioning the head by hand on the manual CMM would take five or six hours, far too long to be a viable method of inspecting the turbine component, and could introduce inaccuracies. Dinesh Prajapati, Director, Nisan Engineering

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. However, inspection was becoming increasingly difficult after the UK company, which traditionally used 3-axis CNC machining centres, installed a 4-axis horizontal-spindle model and a 5-axis vertical machining centre.

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.



The aluminium turbine component being inspected in a cycle time of 10 minutes

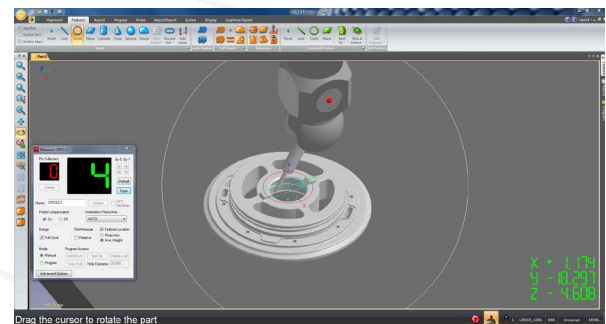


Image of the turbine component on the CAMIO 8 screen of the ALTERA 8.7.6 CMM

Purchase of an ALTERA 8.7.6 CNC CMM, which is built by LK Metrology in Derbyshire (www.LKmetrology.com), 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, identical software was retrofitted to a 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.

Mr Prajapati gave a couple examples of the significant benefits obtained using the new CNC CMM and the upgraded manual 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 LK software.

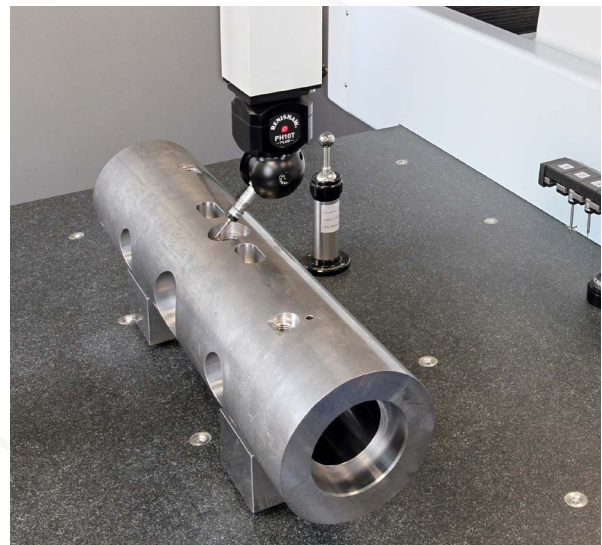


The turbine component being machined on the Spinner 5-axis vertical machining centre

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 carry out other tasks. Tightest tolerance is 10 microns total on the OD and bore.



One of the EN8 gas flow meter cylinders being inspected on the LK ALTERA 8.7.6 CNC CMM

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

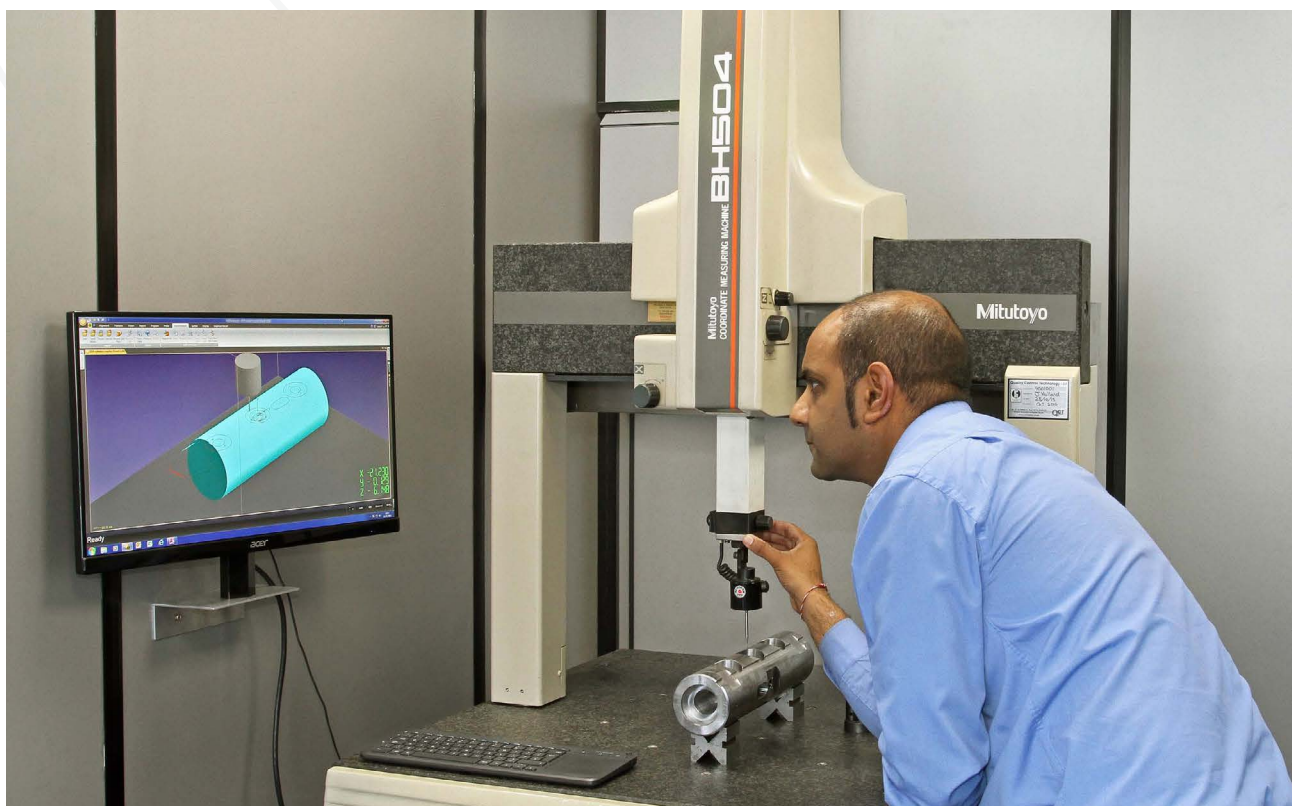
Examining the measurement of a family of EN8 steel components that have been produced in the Leicester factory for many years on an Akari twin-pallet, 4-axis HMC sheds light on the significant advantages of retrofitting Nikon Metrology CMM-Manager software to the manual Mitutoyo.

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, resulting in a more comprehensive inspection. The cycle has to be programmed the first time, but on all



The same cylinder being inspected on the Mitutoyo CMM with CMM-Manager software

subsequent occasions it is available for immediate reuse.

On the BH504, the CMM-Manager 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,

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.

On the BH504, the CMM-Manager 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 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, "Our Mitutoyo CMM software retrofit was completed 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 half a day after 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.

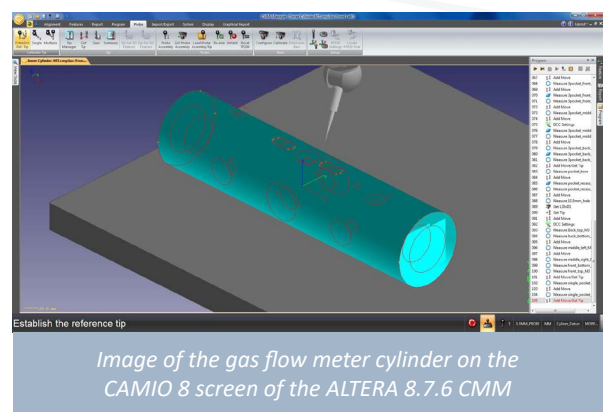
The first-off part is always sent to the metrology department. Then, depending on the size of the run, component complexity and drawing tolerances, every 10th component is typically



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.

Five CMM suppliers were reviewed by Nisan before the purchasing decision was made. Mr Prajapati said that a key point in favour of the LK machine 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."

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 LK CMM and extra software at a total cost of £70,000.

Now that all of the programs for existing repeat jobs have been created, metrology services are being offered to other manufacturers. The facility is available to Nisan's customers and to other subcontractors and OEMs in the area.

About LK Metrology

LK Metrology is renowned for innovative CMM hardware and software solutions. The company's metrology products are used worldwide to control and improve the quality of manufactured components. Its precision technology underpins the process chain from design, development, production and assembly through to quality assurance in global industries such as automotive, aerospace, defence, motorsport, energy, medical and contract inspection.

Established in England in 1963, LK Metrology has an impressive heritage in metrology dating back to the birth of CMM technology. Founded by CMM pioneer Norman Key and his father-in-law Jim Lowther, LK Metrology is credited with many of the CMM industry's firsts including the first bridge-type design, first OEM to integrate computers, first to use a touch trigger probe, first to develop inspection software, first to use all air bearings and granite guideways, first to use carbon fibre composite spindles, first to use microprocessor-controlled drive systems, first to produce a truly thermally stable CMM and first to produce a high-accuracy horizontal-spindle CMM.

In 2018, LK Metrology was relaunched as an independent CMM manufacturer after several years as a division of Nikon Metrology. Headquartered in the UK, LK's CMM development and production are at the company's facility in Castle Donington. Sales and support offices are located in the UK, North America, Belgium, France, Germany, Italy and China, supplemented by a worldwide distributor network.