Automated video measuring speeds inspection by a factor of 60

Dawn Carter inspecting a spark eroded nickel-copper alloy component for a decoy missile on the Nikon Metrology iNEXIV VMA-4540 CNC video measuring system at Microtec.

EDM subcontractor and toolmaker installs Nikon Metrology CNC video measuring to speed accreditation to AS9100 aerospace quality management standard

What does an orbiting telescope currently mapping the Milky Way have in common with the first all-English wristwatch to be produced in half a century? UK subcontractor Microtec EDM, Basildon, supplied prototypes and components for both ventures, as well as for a host of other innovative and high profile projects. The company recently raised the capability of its metrology department significantly by purchasing a powerful CNC video measuring system, an iNEXIV VMA-4540 from Nikon Metrology.

Until the machine was installed at the end of 2014, Microtec relied on manual video measuring using another make of instrument. Owner and managing director, Graham Cranfield advised, "We are currently seven years into an 18-year contract involving electro discharge machining (EDM) and centreless grinding of nickel-copper alloy tube to produce a decoy missile component.

"A complete inspection of the part using our manual video measuring system used to take 20 minutes. Now that the job has been programmed on our new Nikon machine, the same inspection cycle is completed automatically in just 20 seconds. We find that time savings of this magnitude are typical and have revolutionised the productivity of our metrology department."

He explained that it took them only a few hours to create the inspection cycle for this fairly complex job, based on a CAD model of the part. The process will become even shorter as company employees become more familiar with programming. For contracts that frequently repeat, the automated measuring approach saves

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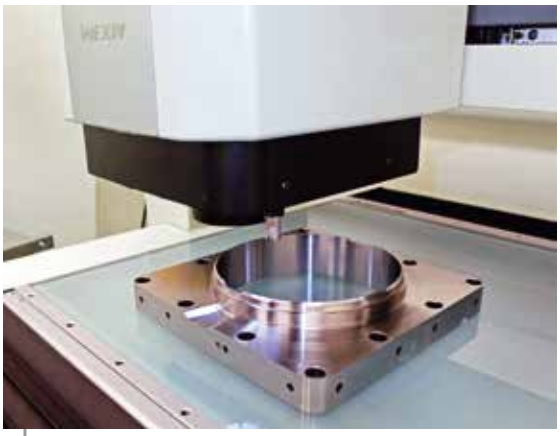


Close-up of a mould cavity ring. Inspection is possible by video measurement or tactile probe

a lot of time in the long term. Even after measuring a dozen of the missile tubes, the programming time had been justified. The component is actually required in quantities of a few thousand every year and even though only one in 12 needs to be inspected, the saving in measuring time during 2015 alone will be more than double the programming time.

By the same reasoning, prototypes and components needed in small batches are more productively inspected manually on the pre-existing video measuring machine, or indeed on the iNEXIV VMA-4540 operated in manual mode.

Wide range of component sizes

Work carried out by Microtec for space missions includes making parts for the joint ESA / JAXA (Japan Aerospace Exploration Agency) BepiColombo mission to Mercury, which will set off in July 2016 on a seven and a half year journey to the smallest terrestrial planet in our solar system. Another project involves the manufacture of prototypes and components for an orbiting telescope.

In both cases, the telescope parts are relatively large. Many other components that the Basildon subcontractor produces go down to 20 microns in size, however, placing the firm in very select group of such specialist providers of wire-cut EDM and spark-erosion services in the UK. A current project in the micro area is the wire-erosion of 70-micron wide vanes in copper and molybdenum grids, required in quantities of 50 per year for an electron beam gun.

Somewhere between these extremes in size lie the components Microtec machines for Charles Frodsham & Co, clockmaker to the British Royal family. In 2015, managing director Philip Whyte plans to launch the first all-English-made wristwatch to be produced on a production basis in half a century. It will be manufactured from start to finish under one roof at the company's workshop near Heathfield, East Sussex.

Close association

Charles Frodsham has a longstanding business relationship with Microtec. The subcontractor regularly wire-erodes gold watch cases and produces springs for the clockmaker, which in turn carries out micro-scale turning, milling and drilling that is beyond the capabilities of Microtec's production equipment.

A smaller Nikon Metrology CNC video measuring machine has been in use at Charles Frodsham's Hastings workshop for about five years. Mr Whyte recommended this make of instrument to Microtec due to its reliability and precision, as well as the strength of after-sales support.

Mr Cranfield benchmarked other potential suppliers' equipment but could not see a better option. In the process, he discovered that some other makes of machine on the market for video metrology actually incorporate Nikon's apochromatic lens, which has better correction of chromatic and spherical aberration than conventional achromatic lenses. It helped him to come to the conclusion that the

Microtec's managing director, Graham Cranfield inspecting a much larger part on the iNEXIV, in this case a steel mould cavity ring.

Nikon Metrology offering was optimal.

Multiple target markets led by aerospace

Aerospace and defence contracts are the mainstay of Microtec's business, Rolls-Royce, BAE Systems, Selex Galileo and Astrium being regular clients. It is the principal reason for Microtec seeking AS9100 accreditation, a process that will be assisted by the purchase of the Nikon Metrology iNEXIV machine. It will be especially important for speeding production of first article inspection reports. The Nikon Metrology VMA AutoMeasure software automatically compares measured results against CAD models and allows such reports to be produced quickly and in standardised format.

Motorsport, closely related technologically with aerospace, is becoming an increasingly important target market for the subcontractor. Medical and dental industry work, which is often defined by complex machining in difficult materials, is another specialism. A current contract involves producing very small tweezers with serrations that are eroded with 20 µm wire, five times thinner than an average human hair.

Another medical job requires a plastic filter mould to be produced with 0.25 mm ribs. Mould and tool manufacture in the 1990s accounted for 80 per cent of Microtec's turnover, dropping to 20 per cent in subsequent years as China absorbed much of the business. Recently, however, the percentage is increasing as mouldmaking is reshored due to an increase in the cost of production overseas as well as problems with quality and logistics.

Projects are also carried out in other industries, such as for premium vehicles including Mercedes and for top-end hifi equipment manufacturer, Rega Research, Southend, for which Microtec manufactures parts for a moving coil cartridge.

Production continues 24/7 at the Basildon factory in a range of materials from aluminium, copper and steel to titanium and exotic alloys. Eight Agie Charmlles EDM machines provide a majority of manufacturing capacity, assisted by Hurco vertical machining centres, a Ghiringhelli centerless grinder and various manual machine tools.

Non-contact 2D and 3D measuring

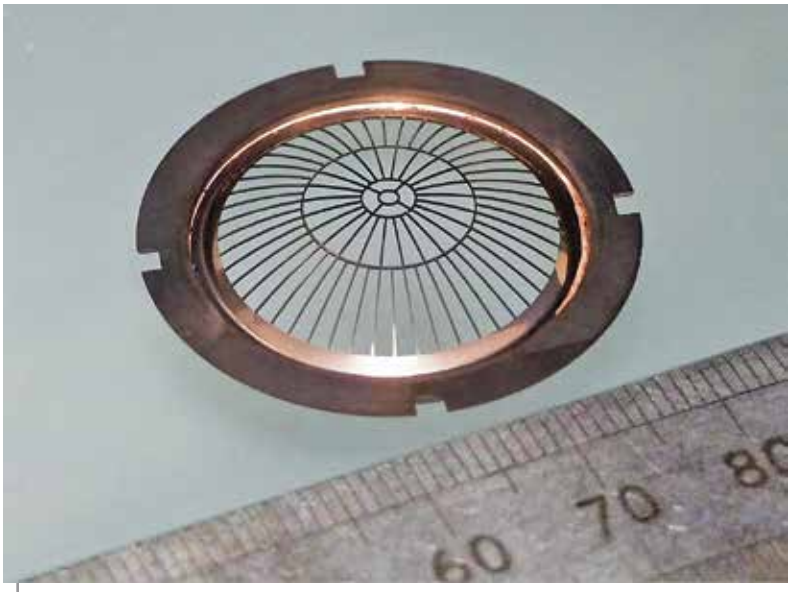
Most wire-cut EDM work requires 2D inspection, for which video measuring is ideal. However, some spark eroded components need to be measured in 3D and one of the advantages of iNEXIV video inspection is the ability to measure heights using the instrument's generous 73.5 mm working distance.

Inspection in 3D extends to mouldmaking. Early in January 2015, Microtec was tasked with refurbishing a plastic injection mould for producing electrical plug sockets for the British manufacturer, MK. No drawings or CAD model were available, so the mould's broken upstands were remanufactured in tool steel by measuring the height and width of the relevant sections on the iNEXIV.

A similar procedure allows reverse engineering of legacy components for which no data exists, such as parts for classic cars. In this case, after the data has been collected, a DXF file is output that can be used directly in a machine tool's CNC or in a CAD/CAM system to generate the cutter paths. Nikon Metrology's part-to-CAD software provides the capability to compare the machined component with the DXF file to ensure that it is within tolerance.

Touch probing capability

Some features on components, such as sloping faces and undercuts, do not lend themselves to optical measurement. In such cases, the



Close-up of the wire-eroded, molybdenum grid for an electron beam gun on the table of the iNEXIV.

The iNEXIV VMA-4540's PC screen shows an image of the area of the component under inspection, current point coordinates, a list of the features inspected, any that are out of tolerance, and more.

iNEXIV VMA-4540 has the facility to accept a Renishaw TP20 or TP200 touch probe to capture the point data. The probe is offset from the optical axis but works in the same 450 x 400 x 200 mm coordinate space, with only slightly reduced operating range. A stylus changer is provided.

Mr Cranfield continued, "We always use vision if we can, as in general it is quicker and more accurate. However, if parts are not the right shape or not scrupulously clean, touch probing is the better option.

"On the other hand, some features would be difficult to inspect with a touch probe, such as the curved surface of a dome, as calculations to compensate for the stylus tip diameter at each measurement point across the surface would be impractical.

"Using the auto focus (AF) feature of the iNEXIV, we can accurately capture heights very quickly. There is also a laser AF option that we are thinking of retrofitting that is very good at highly repeatable Z-axis measurements on flat surfaces."

It is even possible to mix optical and tactile measurements in the same cycle, which is another option that Microtec will be using. For example, the BepiColombo telescope parts require mainly 2D optical inspection of apertures, but there are arrays of 2 mm diameter tapped holes whose positions will need to be probed during the same program.

It is noteworthy that this job will benefit from image stitching within the Nikon Metrology software, as the aluminium components are 550 mm in diameter and will need to be scanned in four quadrants under the 450 x 400 mm X / Y travels of the iNEXIV's moving column. Additionally, stitching of multiple images at different Z-axis heights allows deep components to be rendered all-in-focus.

The instrument's versatility is further enhanced by a variety of illumination options. It has episcopic, diascopic and eight-segment ring LEDs. Combining these enables accurate detection of low-contrast edges.

Even when a workpiece is misaligned, an intelligent search feature automatically locks on to it based on a target image recorded in a teaching file. Detection is assisted by the wide field of view, measuring 13.3 x 10 mm at 0.35x magnification, while zooming in to 3.5x in five steps delivers accurate measurements as well as high resolution images.