

Product news release – 05. February. 2016

## Cranfield Precision's 'Twin Turret' machine will be showcased at Fives' Grindtec 2016, Hall 4 Stand 4030

Fives has developed a new Cranfield Precision machine concept for high precision machining. Conventional machine tool platforms using stacked linear axes as the primary motion control system are capable of supporting traditional material removal processes, but have inherent thermal stability and stiffness issues.



The new Cranfield Precision machine concept is radically different, coordinating two rotary axes and a short linear axis in a 'Twin Turret' design which provides a common platform for multiple machine configurations and processes, including O/D grinding, I/D grinding, profile grinding, milling, polishing, hard turning, diamond turning dicing and in-situ metrology. The resulting machine is far stiffer than conventional machines and has remarkable thermal stability. The machine is supplied in two sizes: TTG100 and TTG400 for up to  $\text{\O}100\text{mm}$  and  $\text{\O}400\text{mm}$  components respectively.





Cranfield Precision TTG100 machine with grinding, polishing, turning (hard and diamond) capability and vertical axis for dicing

3 targeted sectors

### Cranfield Precision product design challenge

Fives challenged its teams to find a radical machine configuration which would act as a common, multi-function platform and could deliver a highly stiff, thermally stable foundation for a wide range of machining processes.

Initial designs were targeted at three sectors:

- The optics industry for grinding spherical, aspheric and free-form surfaces on a wide variety of materials.
- Universal CNC grinding of more conventional parts held in a chuck or faceplate using aluminum oxide or superabrasives.
- Multi-function machining centre offering grinding, milling, turning, polishing and measurement options on a single machine platform.

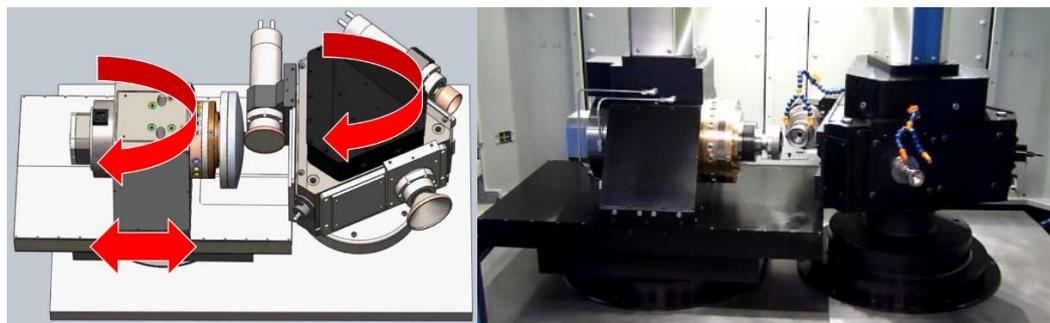
The experiences gained by Fives over many years for its Cranfield Precision range of products in the optic industry show that ductile regime grinding of brittle materials can deliver considerable process advantages over conventional grinding processes. As the name suggests, ductile regime grinding is the removal of material from brittle materials as if the material were in fact ductile, dramatically reducing sub-surface damage and improving surface texture. This mode of operation is difficult to support unless the machine system is extremely stiff, highly damped and capable of sub- $\mu\text{m}$  position control

Fives' expertise within Grinding and Ultra Precision lies in designing & building cam & crank grinding machines for the automotive industry. Again, the trend towards superabrasives demands a highly stiff and thermally stable machine geometry.

### The new machine configuration

The Cranfield Precision TTOG machine uses a unique (and patented) combination of rotary and linear axes to produce relative motion (both position and angle) between tool and workpiece over a swept working area.

Combination of rotary and linear axes



\*Twin Turret machine axes (two rotary, one linear)

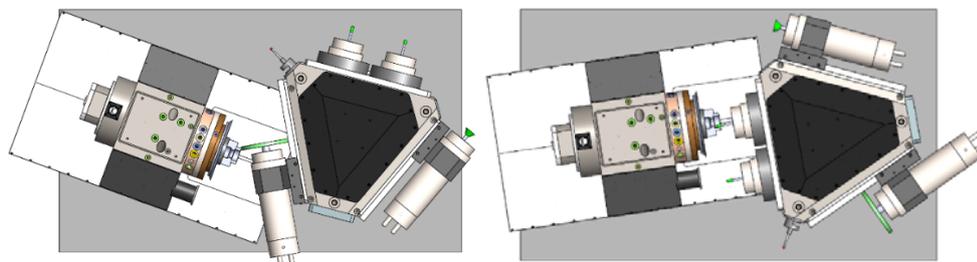
The two rotary axes are rigidly mounted a fixed center distance apart from each other. The rotary axes provide relative motion between the component and cutting tool. The linear axis is used to control the depth of cut and profile shape of the component being machined.



fives

## Grinding | Ultra Precision

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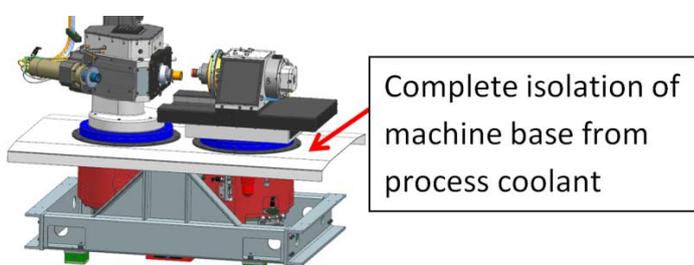
\*The configuration enables multiple machining spindles to be mounted upon a common turret.

Prevents thermal distortions

### Thermal stability

Thermal stability is a major challenge for all machine tools. Conventional grinding machines employing long, stacked linear axes have large, variable thermal loops that can produce significant movement between wheel and component.

Traditional machine designs suffer from constantly changing coolant return path as the grinding wheel carriage moves along the linear axis. The heat from the grinding process is transferred to different sections of the machine bed, resulting in constantly variable machine distortions. The twin turret design enables a simple non-contacting labyrinth seal, making the machine base almost immune to such distortions.



\*Cranfield Precision Twin Turret machine thermal isolation of the machine bed using rotary labyrinth seals

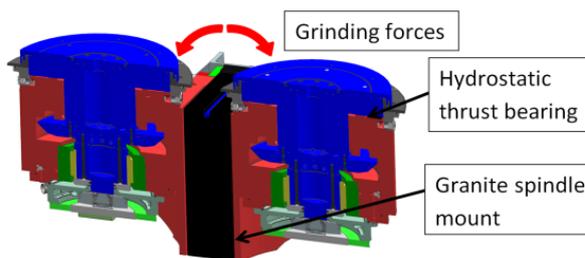
Maximizes machines loop stiffness

### Loop stiffness

In conventional machines using stacked linear axes, the bearing interfaces are more compliant than the machine's base material. Each interface reduces the stiffness of the machine which is counter to the necessity for extremely high stiffness that is needed to support ductile regime and superabrasive grinding methods.

The target for the new design was to use the minimum number of bearing interfaces in the machining loop, thus maximizing machine loop stiffness.

The new machine base is effectively two highly stiff rotary hydrostatic bearings (greater than 10,000 N/μm for the TTG400 version). The Cranfield Precision TTG machine's turrets are bolted together via a solid granite base plate. The machining forces are thus directly resisted by these highly stiff, highly damped hydrostatic bearings. The machine's component workhead and machining spindle assemblies are clamped directly to the highly stiff turret spindle face plates.



\*Rotary turret cross section

Extensive grinding results on a wide range of components have confirmed PV form errors of <250nm on complex profiled surfaces. Optical surfaces have been ground on BK7 glass with sub- $\mu\text{m}$  sub-surface damage and surface textures of <2.5 nm Ra.

Thermal stability between cutting tool and component whilst grinding complex optical components has been shown to be sub  $\mu\text{m}$  over 90 minutes, validating the thermal stability design concept.

The machine has also been used to grind a wide range of automotive components including sub- $\mu\text{m}$  control of match ground fuel injector pins.

The Cranfield Precision TTG100 machine will be shown at GrindTec 2016 on the Fives stand 4030 Hall 4.

#### About Fives in Grinding | Ultra Precision

The Group and its Grinding | Ultra precision dedicated teams - around 650 people in Italy, the U.K. and the United States - offer a complete range of grinding machines, plus a comprehensive line of systems, grinding accessories and service/support programs.

Known worldwide for leading-edge automotive camshaft and crankshaft processing systems, Fives is also a leader in centerless grinding and disc grinding processes as well as lean and flexible CNC grinders for a wide range of shaft-type components for various industries. With a strong legacy based on 4 major brands of the market - Bryant, Cranfield Precision, Landis and Giustina, and more than 200 years of expertise developing pioneering solutions in close partnership with customers, Fives is recognized as the leading provider of grinding and ultra-precision solutions - a partner that helps customers maximize operational performance.

#### About Fives

Fives is an industrial engineering Group with a heritage of over 200 years of engineering excellence and expertise. Fives designs and supplies machines, process equipment and production lines for the world's largest industrial groups in various sectors such as aluminum, steel, glass, automotive, logistics, aerospace, cement and energy, in both developing and developed countries.

In all these sectors, Fives designs and manufactures equipment and innovative solutions, which better anticipate and meet the needs of its customers in terms of performance, quality, safety and respect for the environment.

In 2014, Fives achieved a turnover of 1.6 billion Euros and employed about 8,000 people in over thirty countries.



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