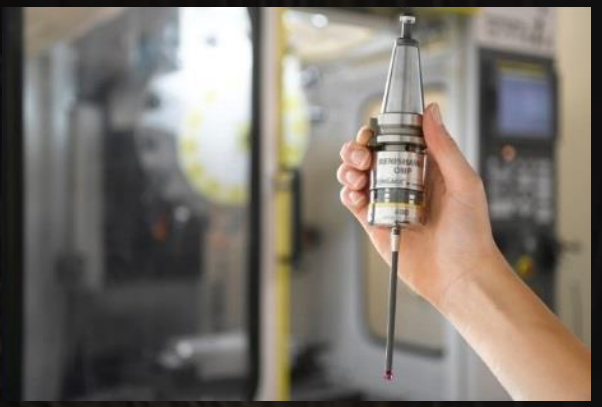
Renishaw and Additive Manufacturing

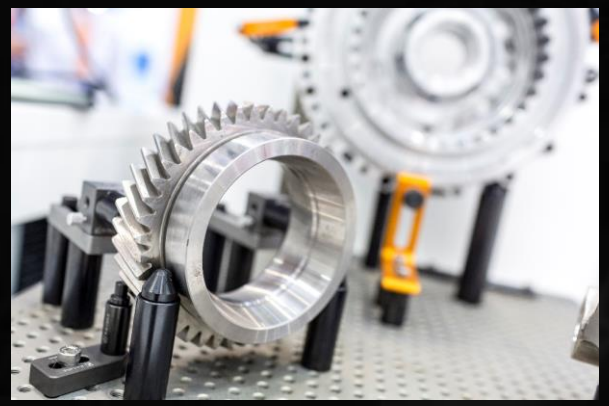
RENISHAW
apply innovation™

About Renishaw

World leading metrology company

A FTSE 250 company with headquarters in the United Kingdom



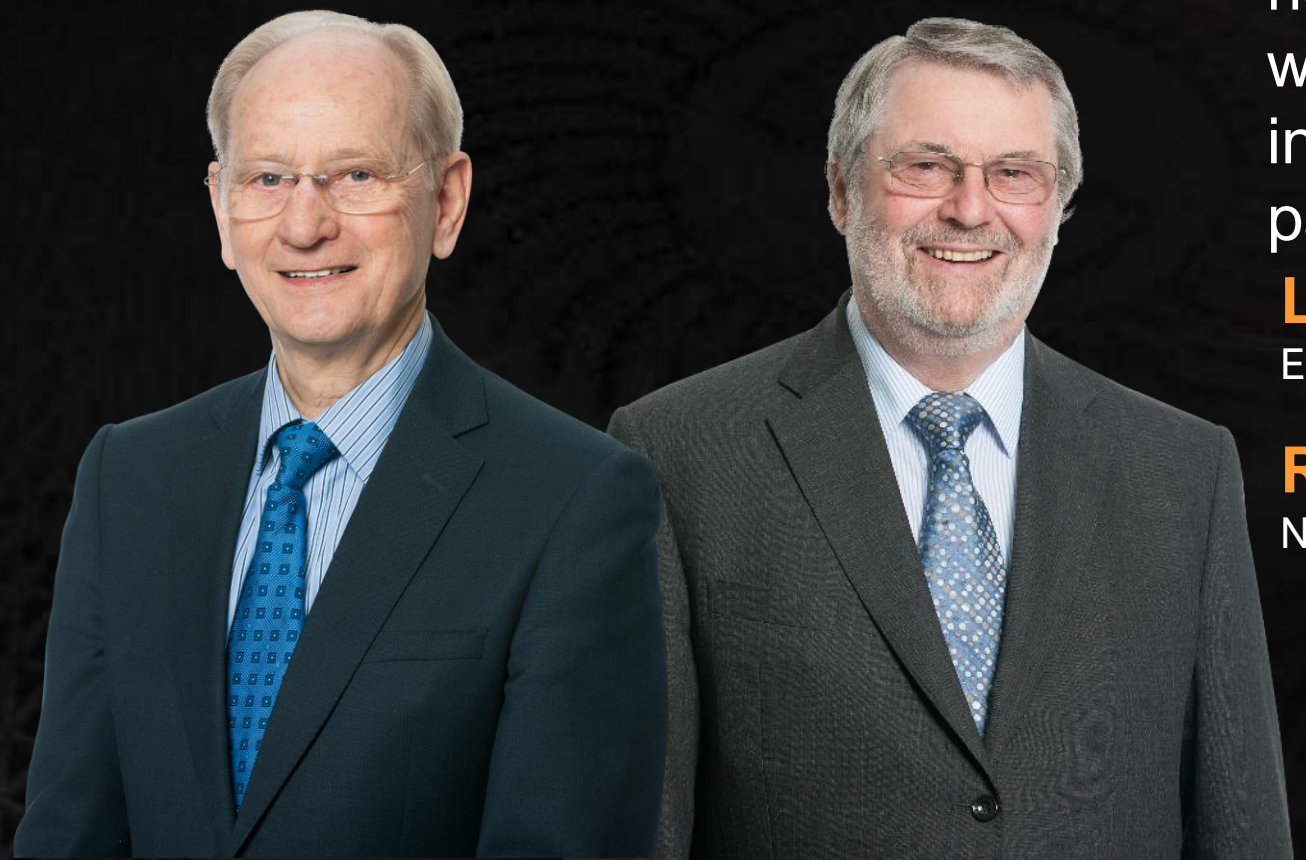


Our ethos

“Renishaw fundamentally believes that success comes from patented and innovative products and processes, high quality manufacturing, and the ability to provide local customer support in all its markets around the globe.”

Sir David McMurtry
Executive Chairman

Vision



"Over the years, we have tried to build a company that is different to most others. Different in how we apply technology to real world problems; in how we invest for the long term; in how we manufacture rather than outsource; in how we treat our customers as partners"

Left: Sir David McMurtry
Executive Chairman

Right: John Deer
Non-executive Deputy Chairman

Our investment in long term growth

"The Group continues its strategy to invest for the long term, expanding our global marketing and distribution infrastructure, along with increasing manufacturing capacity and R&D activities."

William Lee
Chief Executive

Our origins

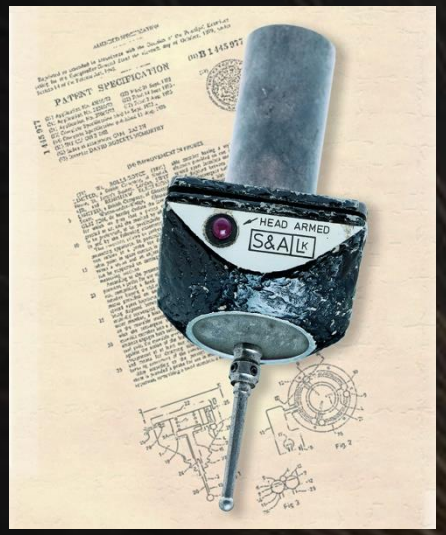
1972 David McMurtry invented the touch-trigger probe to solve a measurement problem for Concorde's Olympus engines

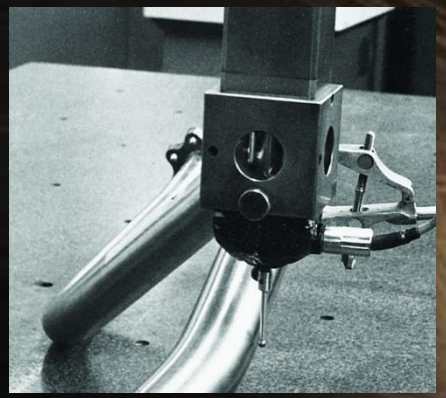
1973 Renishaw Electrical Ltd registered; probe patent licenced from Rolls-Royce

1976 First commercial premises in Wotton-under-Edge, Gloucestershire, UK

1977 First dedicated probe for machine tools

1984 Full listing for Renishaw plc shares on the London Stock Exchange



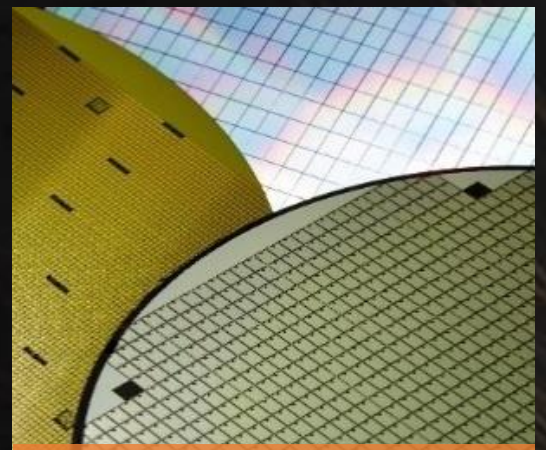


Our strategy

Our customers

Aerospace

Automotive



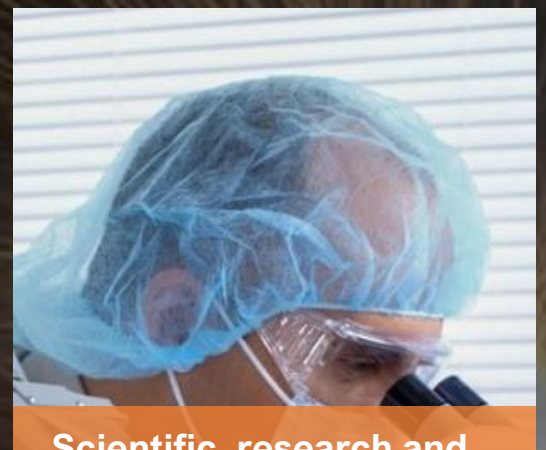
Electronics

Energy

Heavy industry

Medical and healthcare

Precision manufacturing

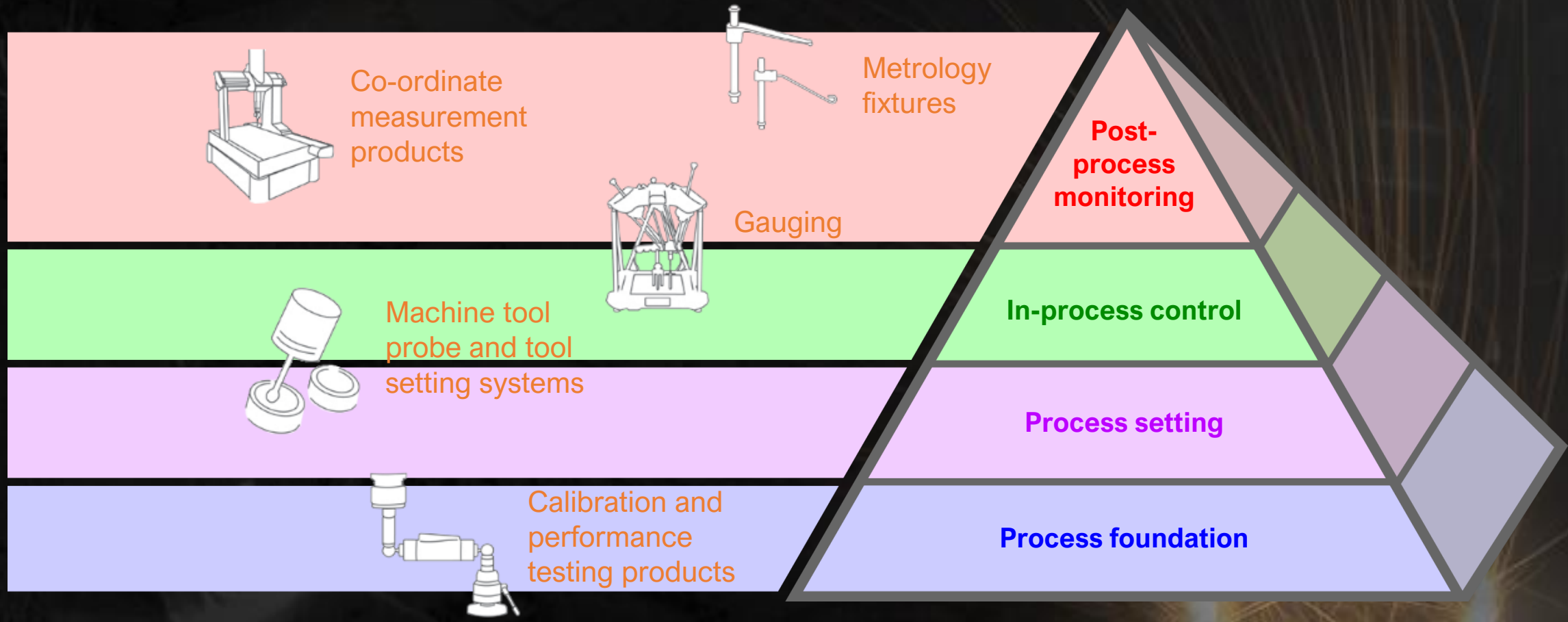


Scientific, research and analysis

Highlights in 2021*

*All figures for year ending June 2021

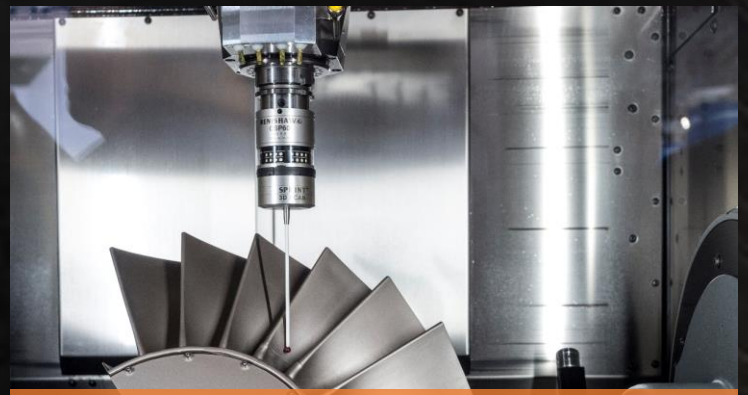
Our expertise – Manufacturing process control



Our expertise

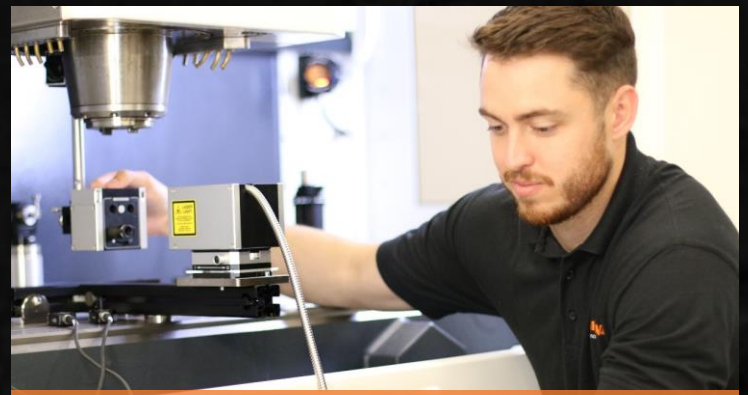
Industrial metrology

CMM probes, software and retrofits

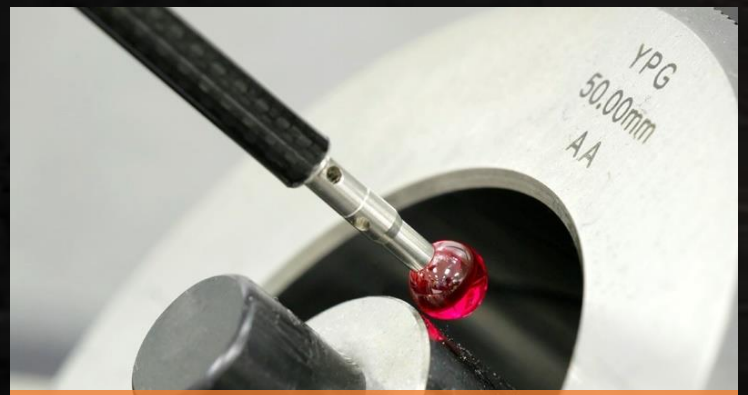


Machine tool probes and software

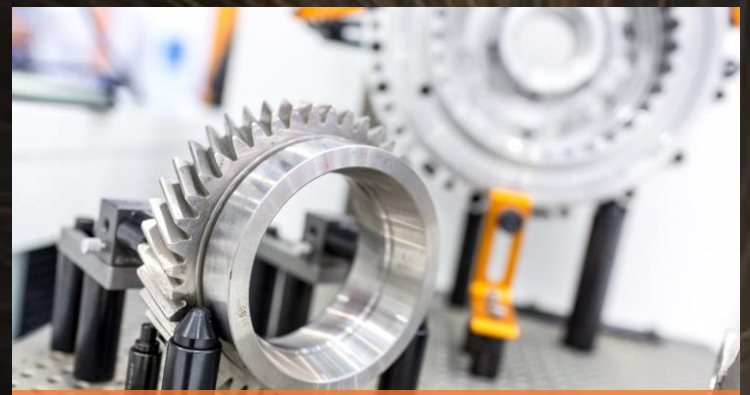
Automated gauging systems



Machine calibration and optimisation



Styli for probes



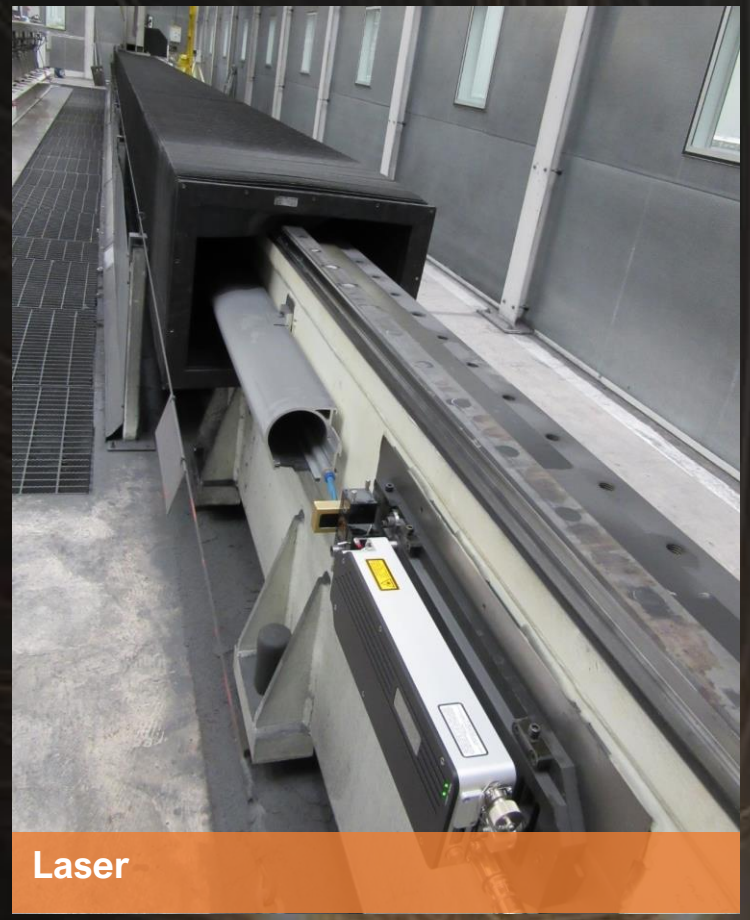
Metrology fixtures

Our expertise

Position encoders

Magnetic

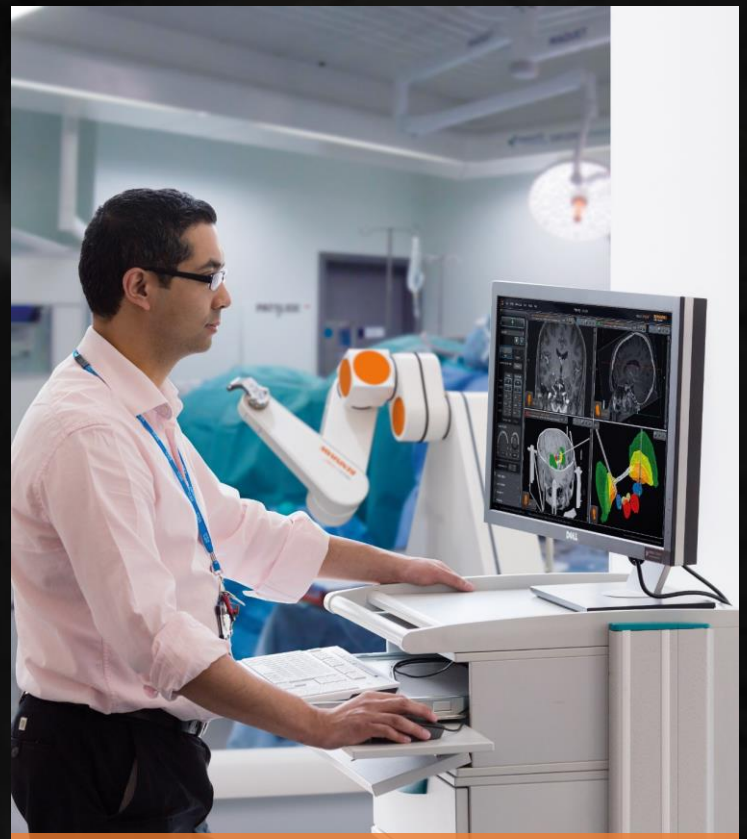
Optical



Laser

Our expertise

Healthcare



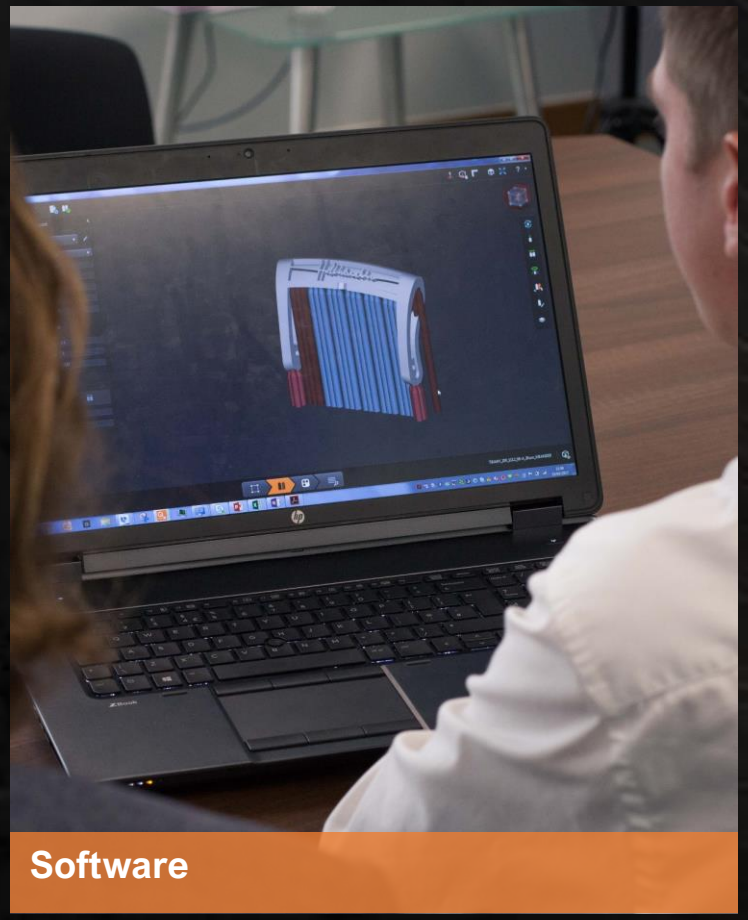
Neurological products and therapies

Raman spectroscopy

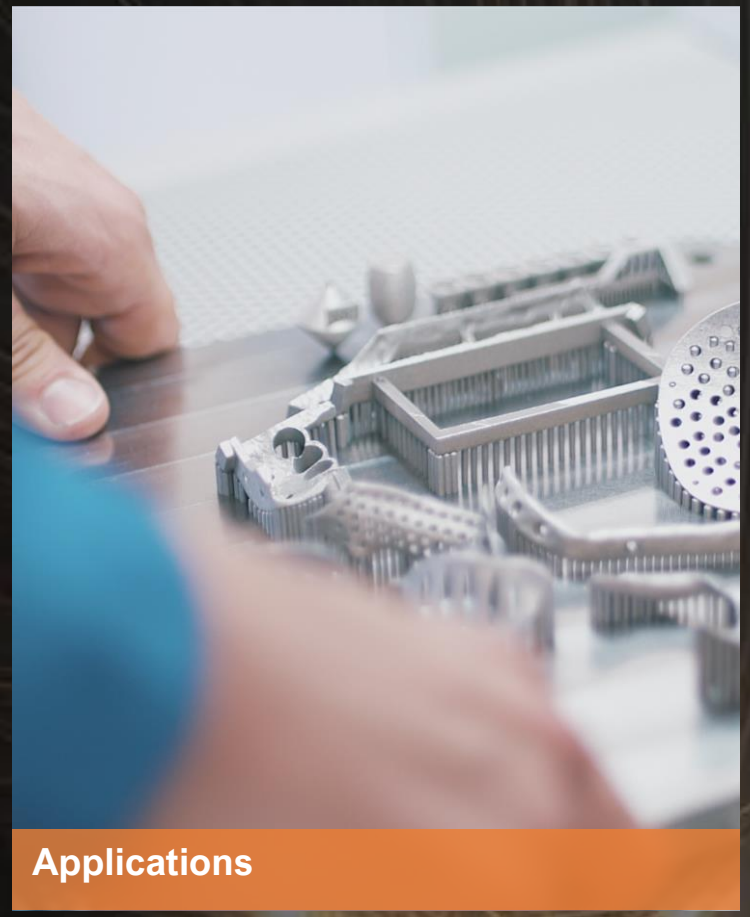
Our expertise

Additive manufacturing

Systems



Software



Applications

Global Overview – Key AM Centres

Headquarters
Renishaw Innovation Centre (RIC)
153,000 ft² (14,200 m²)

Cardiff
Manufacturing plant
461,000 ft² (42,800 m²)

Customer support

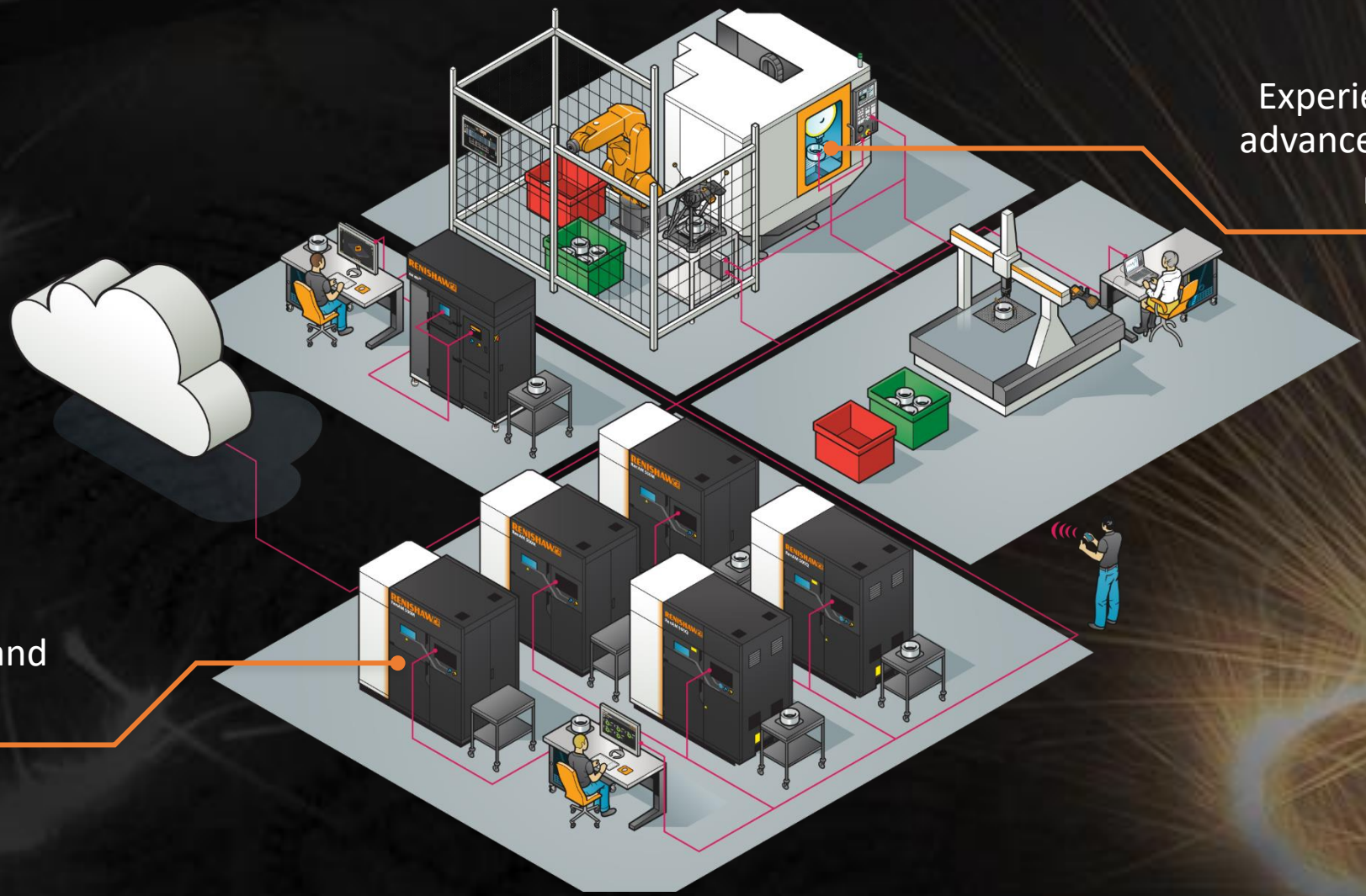
Renishaw offers exceptional customer support

Support from multiples engineers based in the UK, Chicago and Barcelona with expertise in a vast array of industry sectors

Renishaw can help you achieve

- Light weighting
- Part consolidation
- Improved functional performance
- Shorter development cycles
- Reduced design constraints / greater design freedom

Options for an end to end process



Experience developing advanced manufacturing processes

AM technology and know-how

Faster and more cost effective without compromising on quality

Aerospace

Automotive


Exchanging metal 3D printing solutions with HiETA


Renishaw produces a prototype nose tip for the BLOODHOUND Supersonic Car SSC


Metal 3D printing pushes the boundaries in Moto2™ through defiant innovation

Medical


Case study

RENISHAW apply innovation

Additive manufacturing for serial production of orthopaedic implants


Case study

RENISHAW apply innovation

Digital evolution of cranial surgery


Case study

RENISHAW apply innovation

Egan adopts digital workflow for Removable Partial Dentures (RPD)

Systems

Key features of RenAM 500 series

- Intelligent gas flow system
- High precision dynamic optical control
- Controlled powder management
- Connected and intelligent sensing technologies

- Increasing productivity
- Reducing cost per part
- Without compromising on quality

Intelligent gas flow

Vacuum build chamber preparation

- Patented vacuum build preparation system to rapidly reduce the oxygen level

Gas flow control

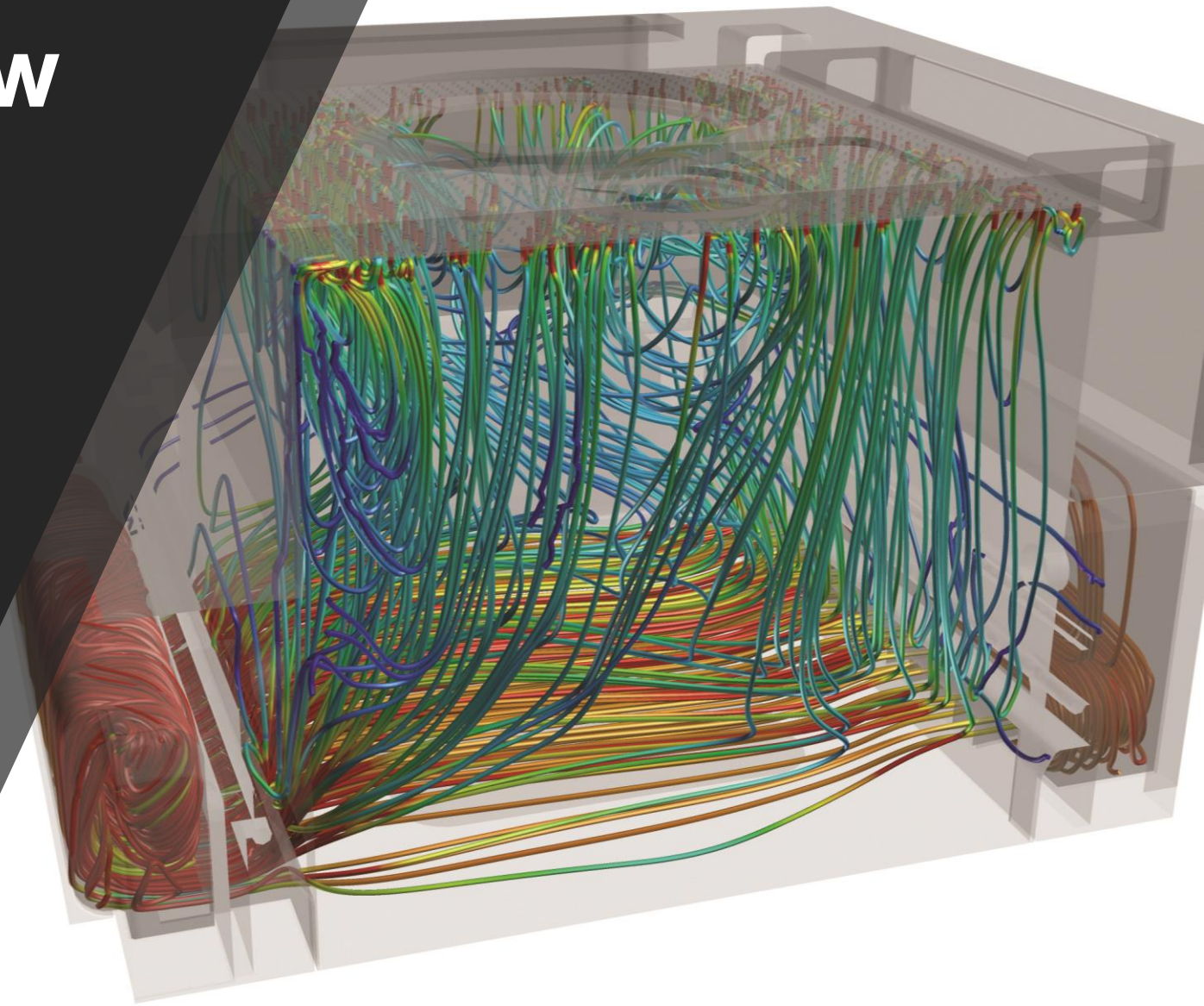
- Intelligent gas flow efficiently removes process emissions in a stream of inter argon gas leaving a clean build chamber

Intercooler

- The intercooler reduces and stabilizes the temperature of the argon gas stream by cooling the recirculating gas

Dual SafeChange™ filters

- Dual patented SafeChange™ filter system to capture the very smallest process emissions in an inert argon gas atmosphere



High precision optical control

High performance laser guiding technology

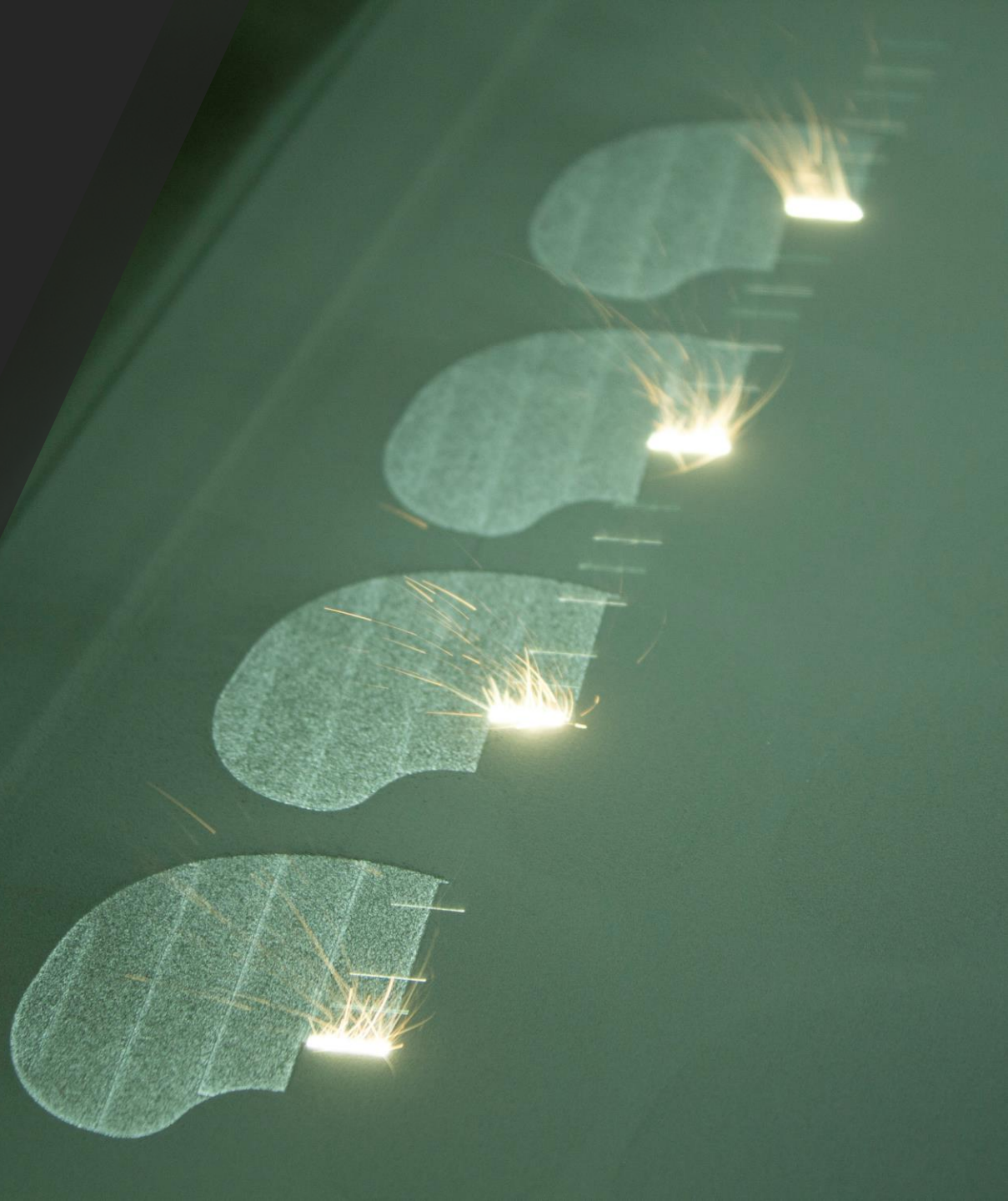
- To deliver accuracy at the powder bed takes expery optical and control engineering, something Renishaw has spent years perfecting

High precision z-axis

- The z-axis is equipped with a Renishaw RESOLUTE™ optical encoder with a 1 nm resolution for high-accuracy positional sensing

Kinematic re-coater with flexible blade

- A kinematic re-coater mounting for rapid and precise re-coater changes reduces operator error and improves turn-around time



Controlled powder management

Cyclone pre-filter separator

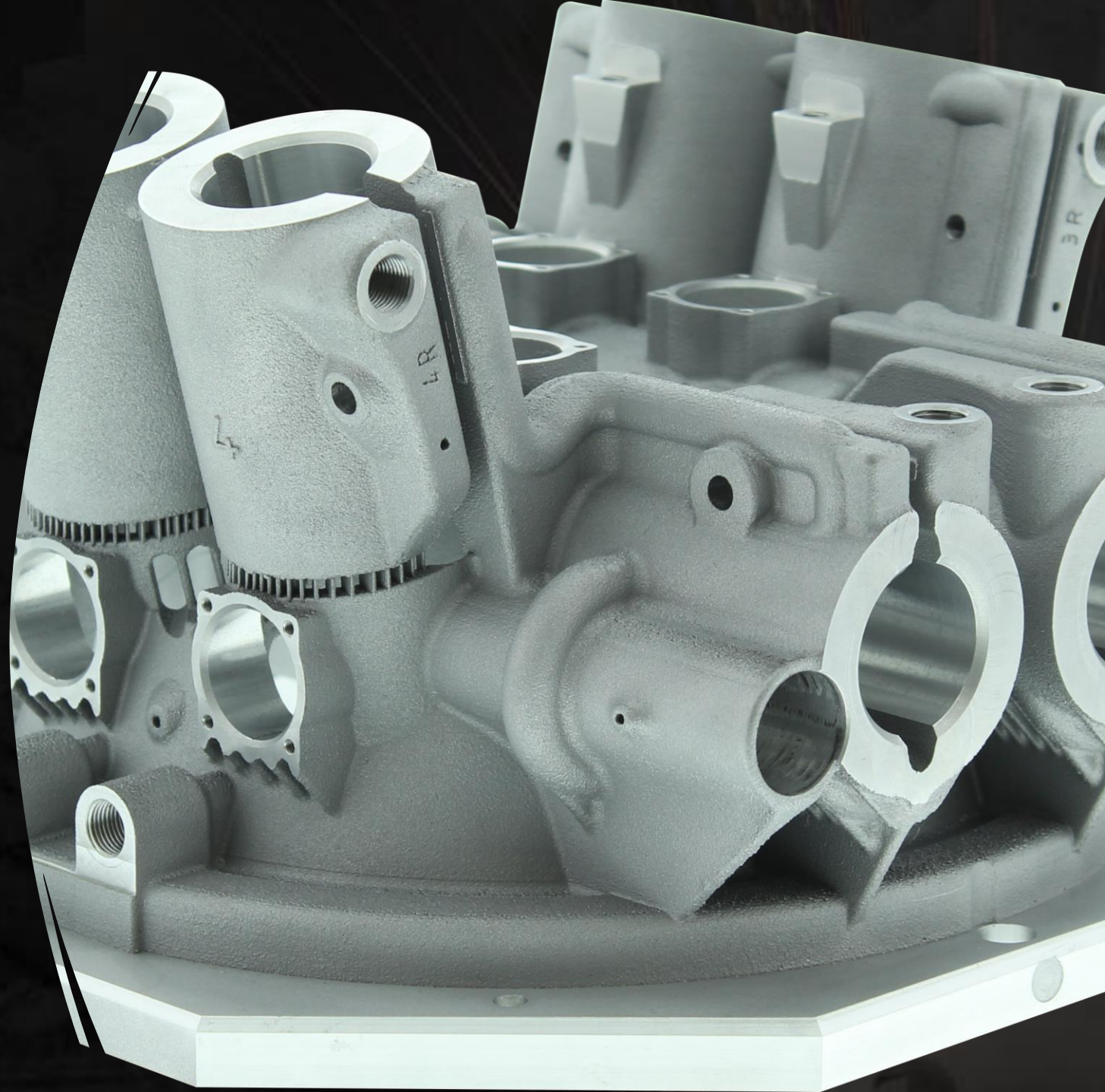
- To allow high volumes of gas at a high velocity to be use, a pre-filter cyclone separator capture larger process emissions from the gas stream before they reach the SafeChange™ filters

Built-in sieve and powder recirculation system

- The built-in sieve and powder recirculation system ensures all powder handling is automated and under a safe gas argon atmosphere.

RenAM 500Q – Additively manufactured galvo mounting

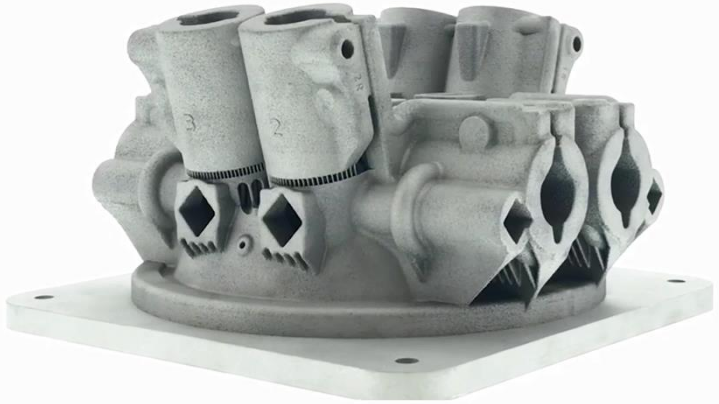
- Full field of view for all lasers with unmatched precision
- RenAM 500Q uses 8 digital galvanometer mirrors closely mounted in a single additively manufactured module.
  - Additively manufactured from AlSi10Mg
  - AM delivers significant performance benefits over traditional manufacturing methods.
- Lasers mounted close to the centre of the working area, combined with optimised fluid cooling, significantly reduce the thermal and mechanical errors associated with separate optical module designs.
- Designed to provide each laser with full field of view for optimum production efficiency.



Standard vs high productivity

2 lasers

4 lasers



Build progress after 19 hours

The different systems within the 500 series

RenAM 500Q & 500S

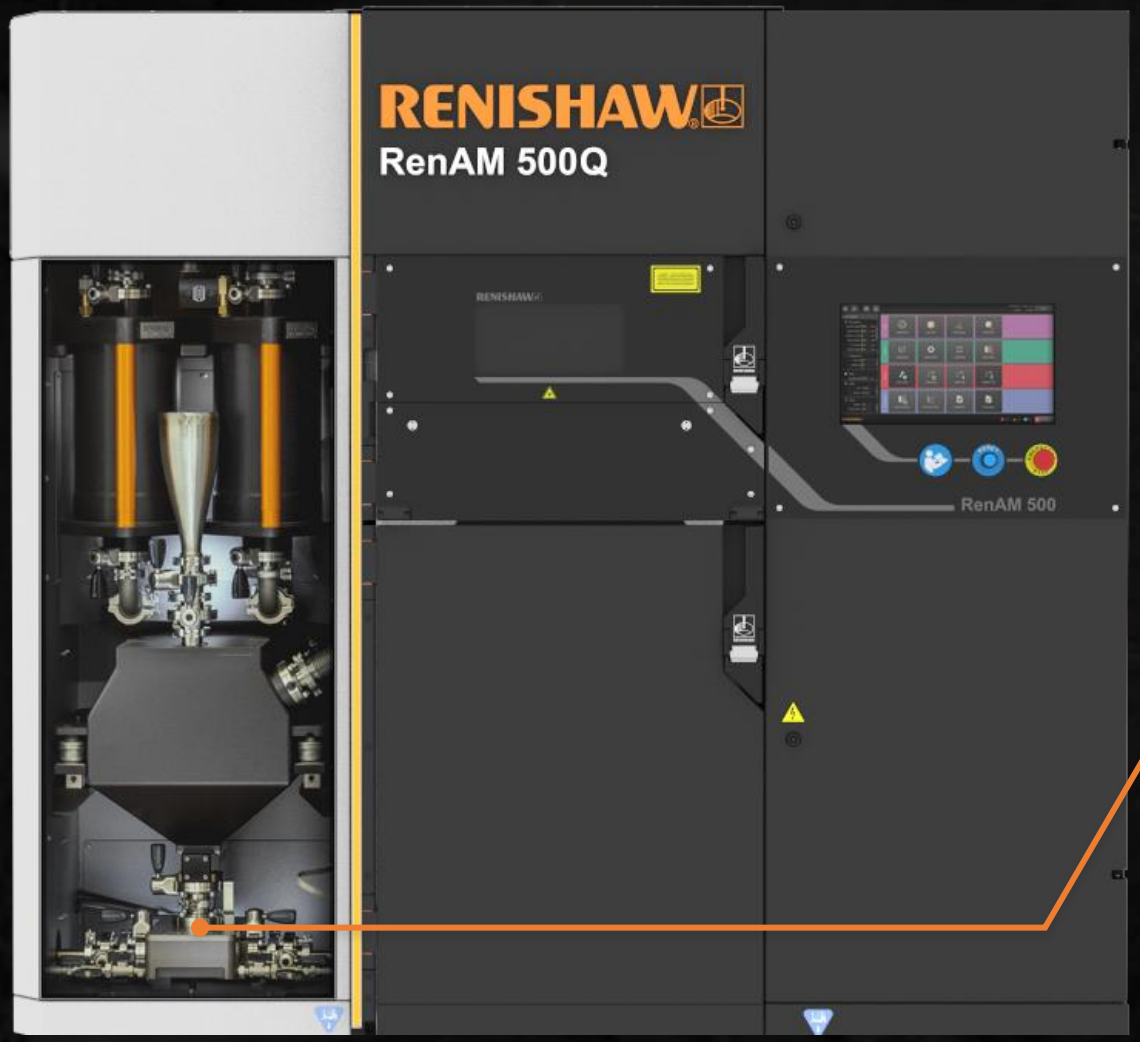
High volume production of a broad range of components, supplied with an integrated recirculating powder system

RenAM 500Q Flex & 500S Flex

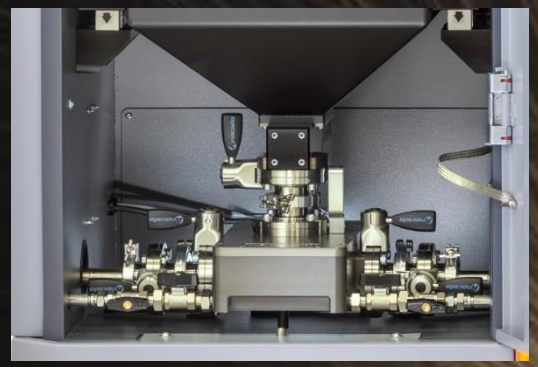
High volume production of a broad range of components, supplied with a batch control powder system.

Platform X/Y size: 250 mm
Q: Quad Laser version
S: Single Laser version

RenAM 500Q & 500S – Delivering productivity through product innovation



Automatic powder recirculation system with integrated sieving and vacuum & inert gas control



- On-board sieving

RenAM 500Q Flex & 500S Flex – stand alone or integration into a factory powder supply system

Powder hopper or gravity fed centralised delivery system

Systems keep core features such as vacuum assisted inert gas supply and fully open parameter.

Powder collection containers or connection to a centralised powder collection system

Software offerings

For more details see software presentation

QuantAM

- Two separate “products” – QuantAM App and QuantAM Post Processor
- QuantAM App – User interface for build preparation
- QuantAM Post Processor – Software interface for producing build files within 3rd party software applications

InfiniAM Central

- System sensor and build information software.

InfiniAM Spectral

- Live analysis and post build investigations

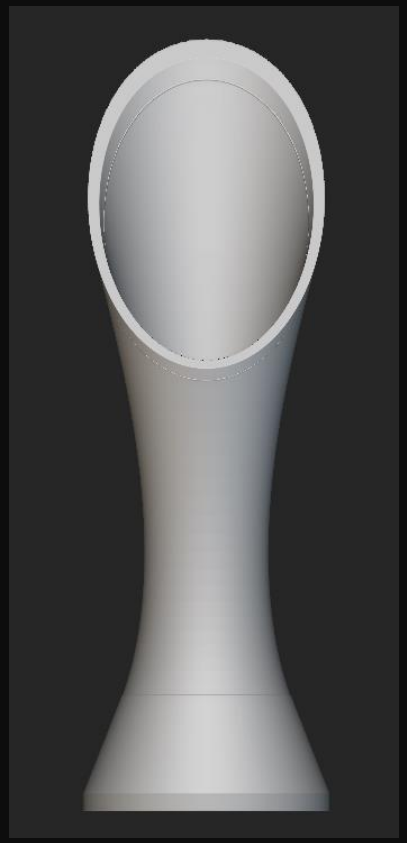
Machine Software Suite

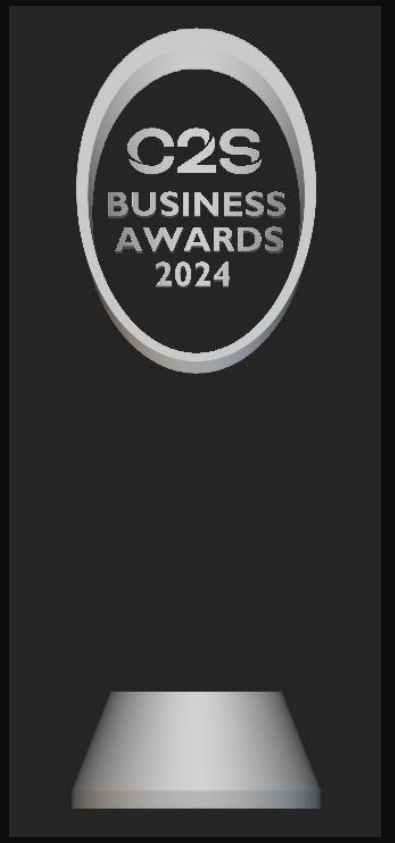
- All software on AM Machine – RenAMP, Camera App, Windows etc.

C2S Award Design & Build Process

The Initial award concept was designed in Siemens NX cad software this was then imported into nTop Topology optimization software to generate the lattice for lightweighting of the award.

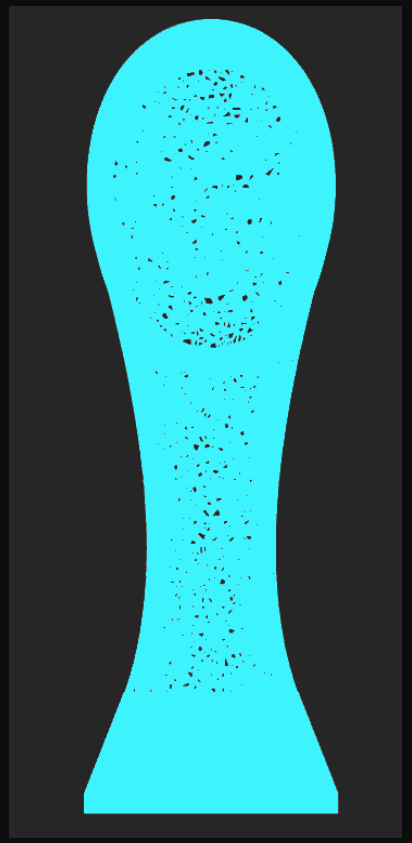
The Logo was used as a field to create a variable thickened lattice to allow for no support regions in these areas

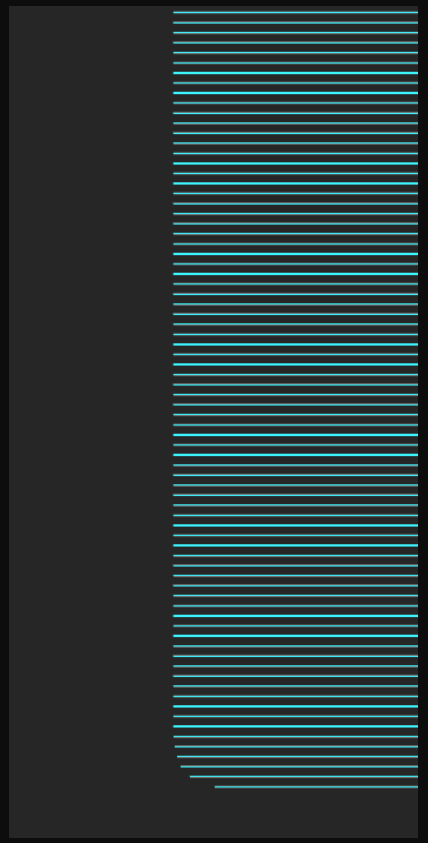




C2S Award Design & Build Process

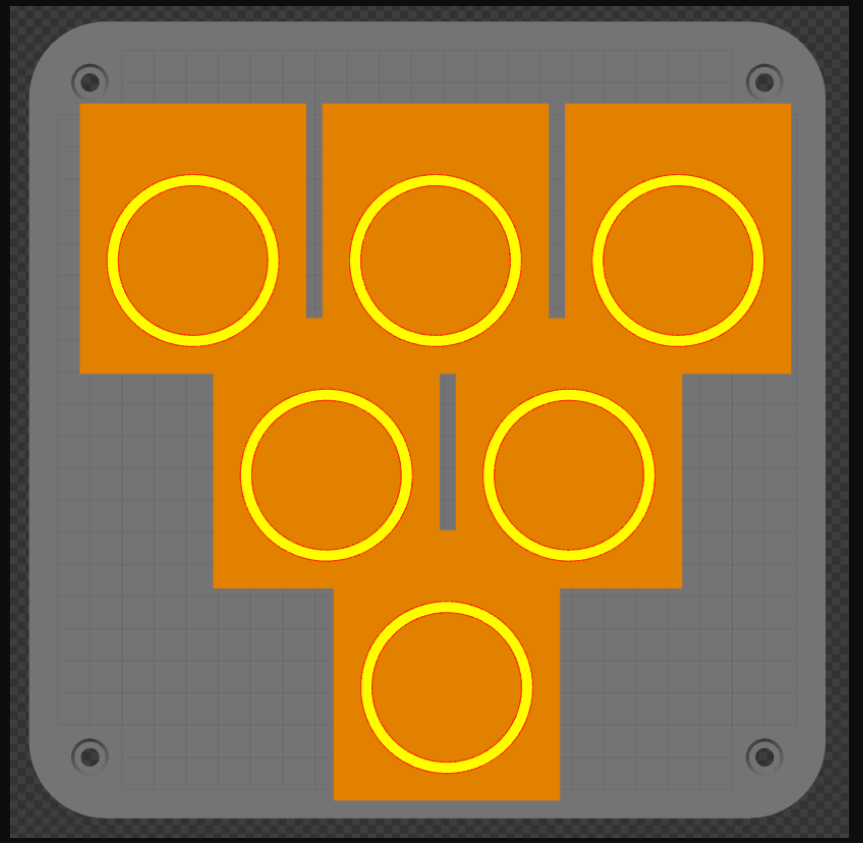
The final design part was sliced into 60 micron layers in Ntop prior to exporting CLI file into QuantAM the software used for generating the AM machine build file.





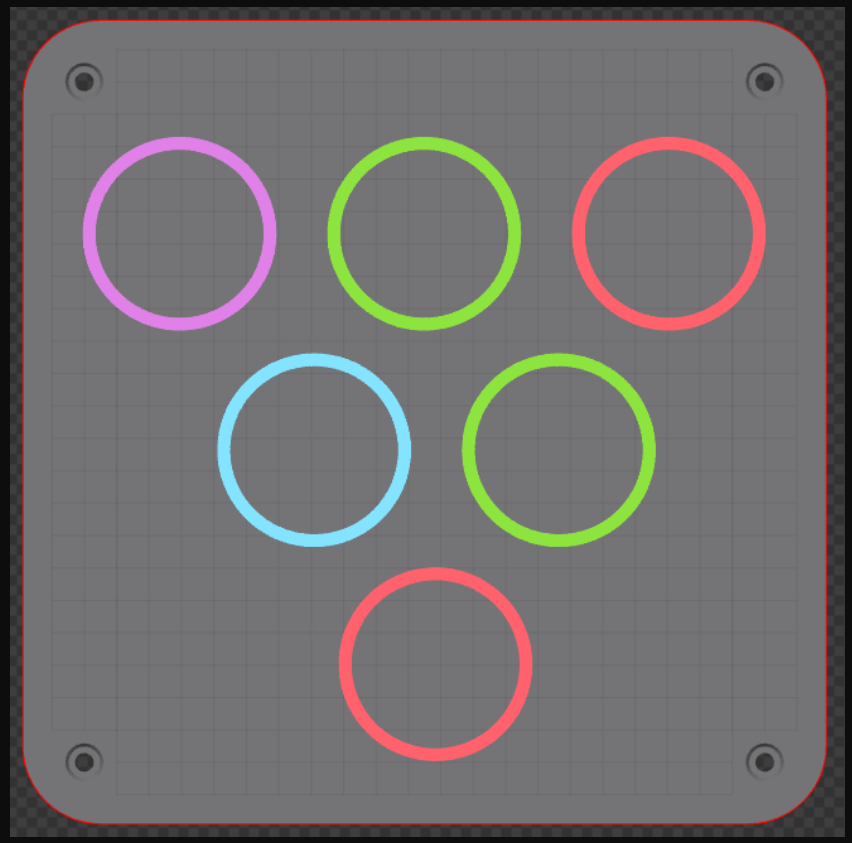
C2S Award Design & Build Process

The individual x1 CLI file was imported into QuantAM and then duplicated to allow for x6 awards per build at this stage the material selection was made Inconel 625 and a parameter selected to optimise part quality and finish.



C2S Award Design & Build Process

The next process was to assign lasers to each award to utilise the multi laser system and minimise build time and to export the .mtt file ready to run on the RenAM 500Q.



C2S Award Design & Build Process

The build is run and takes approx 12 hrs to complete x6 Awards. This build was repeated x3 times to complete all x18 Awards

C2S Award Design & Build Process

The final build is de-powdered and removed from the build chamber.

C2S Award Design & Build Process

Once all powder is removed the Awards are set up on a wire EDM machine to cut the parts off from the build plate. Each individual part is then ready for post processing.

The final steps for post processing are.

- File and smooth out top ring and Text using rotary finishing tools.
- Fine Ceramic bead blast whole Award.
- CNC Etch Award winner text.
- Final polish of Main Logo.