The World's First Hybrid Turbine Blade & Turbo Fan Remanufacturing Machine

HSC-turning-milling centre of the HSTM-series: HSTM, HSTM XL and HSTM HD

HAMUEL REICHENBACHER

A member of the SCHERDEL group

50% 3D Laser Cladding Machine
50% Milling Machine with 3D Scanning

= 100% Automated & Adaptive Repair Solution
for High Value Components

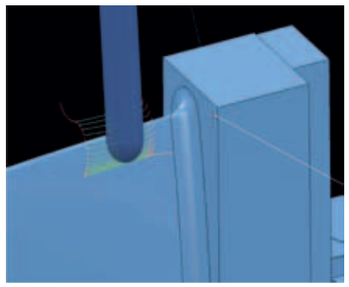
What is a Hybrid machine?

A Hybrid machine is one where you can change between manufacturing processes as easily as you change between milling cutters. Hybrid machines mix technologies together to allow processes to be combined, as required. The ability to extend end-of-life of high value, complex components made from specialized materials, is both cost effective and environmentally friendly.

Don't just load your machine with milling cutters; load it full of adaptive processes: **High Speed Milling + 3D Scanning + Laser Cladding + 3D Inspection + Deburring / Polishing + Laser Marking .... all in a single machine!**

"The hybrid manufacturing machine is the most flexible system for remanufacturing worn parts and consumes only a fraction of the energy, time and cost required to manufacture new parts."

Prof. David Wimpenny
Technology Manager Net Shape and Additive Manufacturing
The Manufacturing Technology Centre, Coventry, UK.



Generation of a milling path using an adaptive CAM-system

3D-measuring of a turbine blade in the HSTM

High-speed machining of difficult to machine materials

How does it work?

Flexibility – The key to Hybrid manufacturing is flexibility. Switching between milling, cladding & probing is fully automated and fast. Changeover takes less than 20 seconds and can be called up during any part programme using only a few M-codes. A typical fully adaptive part programme may include any of the following steps, all adaptively controlled by a single software solution.

Adaptive processing through in-cycle reverse engineering: The key to mixing processes is feedback. In-cycle part inspection provides feedback to orient parts, assess defects, and ensure accuracy throughout processing using adaptive automation software.

Adaptive processing customizes the NC programme to best repair each component to deliver exceptional accuracy and reliability – even when repairing parts with varied service histories. Adaptive manufacturing is central to many aerospace applications including blade / blisk production, component repair etc. All processing in a Hybrid machine is automatic and can be adaptive.

3D laser cladding is essentially a welding-based 3D printing (also known as additive manufacturing) technique which melts metal with a laser and deposits it onto a part. It can be done with virtually all conventional welding metals plus the focused heat input and low dilution allow cladding of difficult to weld materials. It has been relied on in industry for 15 years for repair work and complex 3D printing.

Laser cladding in a mill-turn machine creates a new price point for these systems and has the added benefit of being able to surface finish deposited metal by milling / polishing in a single setup.

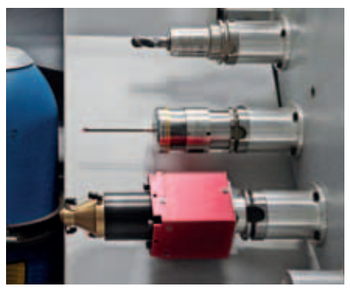
Above all, the Hybrid machine delivers all of the above capability without any compromises to the milling quality that HAMUEL is known for.

High speed 5-axes milling continues to be improved at HAMUEL with its unique machine layout, superior spindle performance and optional CO_2 cooling.

Optionally the spindle is also capable of final polishing, etc.
The Hybrid system fits the entire range of HSTM, HSTM XL and HSTM HD machines.

Tools for laser processing and machining

Polishing tools for leading and trailing edges

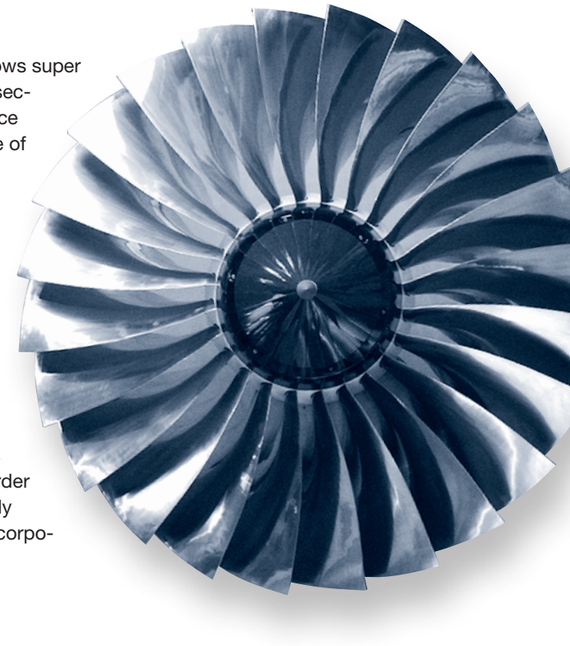


Tool, measuring probe and fibre laser unit in the tool changer

Applications for Hybrid Machines

Aerospace, gas or steam turbine blade or blisk repair:
This new technology has been developed in order to improve the repair of turbine blades by completing many operations together in an automated cycle. Removing the manual operations ensures consistent quality, minimizes the cycle time, and results in reconditioned parts at a fraction of the cost of producing a new component.

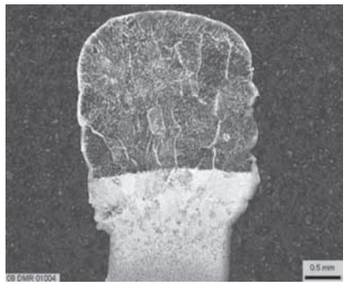
Our Hybrid technology also allows super alloys to be clad onto specific sections of blade profiles to enhance the properties and performance of the component. Targeted cladding with additional material can reinforce parts structurally or improve the durability or chemical resistance of the parent material.



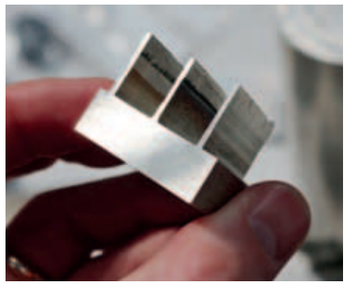
The continued development of “Contoured Leading Edge” or “Profiled Leading Edge” blades by different manufacturers in order to reduce engine noise, is ideally suited to our machine and is incorporated within the cycle to further perfect this feature.

Compact and affordable – Combining the capabilities of 5 different machines (5 axes CNC milling, Laser Cladding Cell, Robot Polishing Cell, CMM and Laser Marking) in a single machine, saves on floor space and costs only a fraction of a multi-machine repair cell.

What is the quality of the clad material?
Laser cladding is an established method, employed in safety critical applications, which allows high integrity material to be deposited with properties which can exceed those of the base component material.



Material sample to prove the optimum bond with the clad material



Laser-clad material

Increased sustainability for high value metal parts

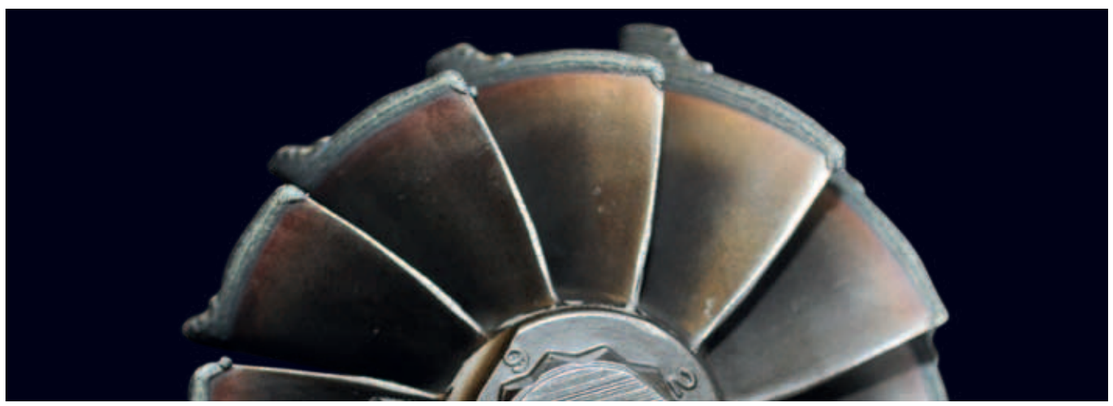
The Hybrid system is capable of remanufacturing high value metal components in order to give them a second life without the need to manufacture a new part. This results in a decisive cost advantage, in particular so where high value and intricate components are concerned.

The picture shows how it is possible to repair a worn blade on an impeller. Using a hybrid machine, it is possible to remove the damaged area by milling off the worn part, then build the material back up by laser cladding, without having to remove the part from the machine between operations. This method delivers the utmost precision, repeatability and reproducibility.

Benefits from the clad material
In addition to restoring worn or damaged material to a part, laser cladding can combine different materials together to enhance component performance. For example, laser cladding allows the effective combining of different materials. This permits a part made from a parent metal with good structural properties (chosen for its strength, ductility and toughness) to be surface coated with a harder or more inert material to improve its wear or corrosion resistance. In this way the composition and topology of parts can be optimized for long lasting performance in harsh or extreme operating conditions.

With appropriate processing parameters, the clad and parent materials achieve a very strong bond at the interface. This is critical because the relation between the base substrate and the cladding material plays an important part in the deposition process and ultimately determines the part properties and microstructure. A central aspect of the know-how required for this process is the compatibility between various materials. Numerous studies and analyses of different combinations have been undertaken to enable this process to perform at the highest quality level meeting standards for the aerospace industry.

The characteristics of the cladding and parent metal and the condition of the bonding area are decisive for the quality of the bond between the two materials, thus, it determines the final strength of the product.



The Hybrid machine has been developed by the following team:

Six years ago, active use of a high speed milling machine was initiated in a 3D printing research laboratory. The cross-pollination of additive and subtractive technologies led to a UK-based research project which has matured into the Hybrid machine system of today.

HAMUEL has worked with a world-leading team to mature this technology into a full-scale industrial repair solution on their machines. Delcam's CAD / CAM software is at the heart of the system integrating and driving all of the processes. Hybrid Manufacturing Technologies has developed the automatic switch over between processes. The Manufacturing Technology Centre has been responsible for the 3D laser cladding process and applications development. This team allows Hamuel to offer customers unrivalled levels of service and expertise and bring truly revolutionary technology to a rapidly evolving industry.

Delcam
Complete CADCAM Solutions
www.delcam.com

Delcam supplies software and services that help companies to increase productivity, improve quality and reduce lead times. Delcam is a leading supplier of computer-aided machining software, and also develops product design, tooling design and inspection programmes. Delcam software is used in over 80 countries by more than 40,000 organisations.

HYBRID MANUFACTURING TECHNOLOGIES
www.hybridmanutech.com

Hybrid Manufacturing Technologies, based in the UK, specializes in combining additive and subtractive processes integrated into CNC and robotic platforms. Its patent pending series of docking solutions allows automated changeover between processes in less than 30 seconds enabling agile advanced manufacturing for repair or new component fabrication.

mtc
Manufacturing Technology Centre
www.the-mtc.org

The MTC represents one of the largest public sector investments in manufacturing for many years and is housed in a 12,000 square metre purpose built facility at Ansty Park, Coventry. It is a partnership between some of the UK's major global manufacturers. We provide a high quality environment for the development of cutting edge technologies into manufacturing processes with the aim of delivering truly innovative solutions to UK industry.

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Almost 100 years of experience in mechanical engineering, as well as about 30 years of know-how in CNC-machining are self-explanatory: nearly 4,000 CNC-machines produced by this group are in use in the most diverse industries all over the world. Many in-house developments and patents document the great inventive capacity of this group of companies.

The SCHERDEL group acts world-wide with 29 sites and 37 manufacturing companies employing more than 4,000 people, about 600 of whom are in the fields of mechanical and plant engineering, as well as tool manufacture. The strong synergies inherent in our group of companies together with our focus on service allows us to provide customers with comprehensive solutions to their problems.

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REICHENBACHER
A member of the SCHERDEL group

HAMUEL Maschinenbau GmbH & Co. KG
Industriestraße 6 · 96484 Meeder (Germany)
Phone: +49 (0) 95 66-92 24 0 · Fax: +49 (0) 95 66-92 24 80
info@hamuel.de · www.hamuel.de

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