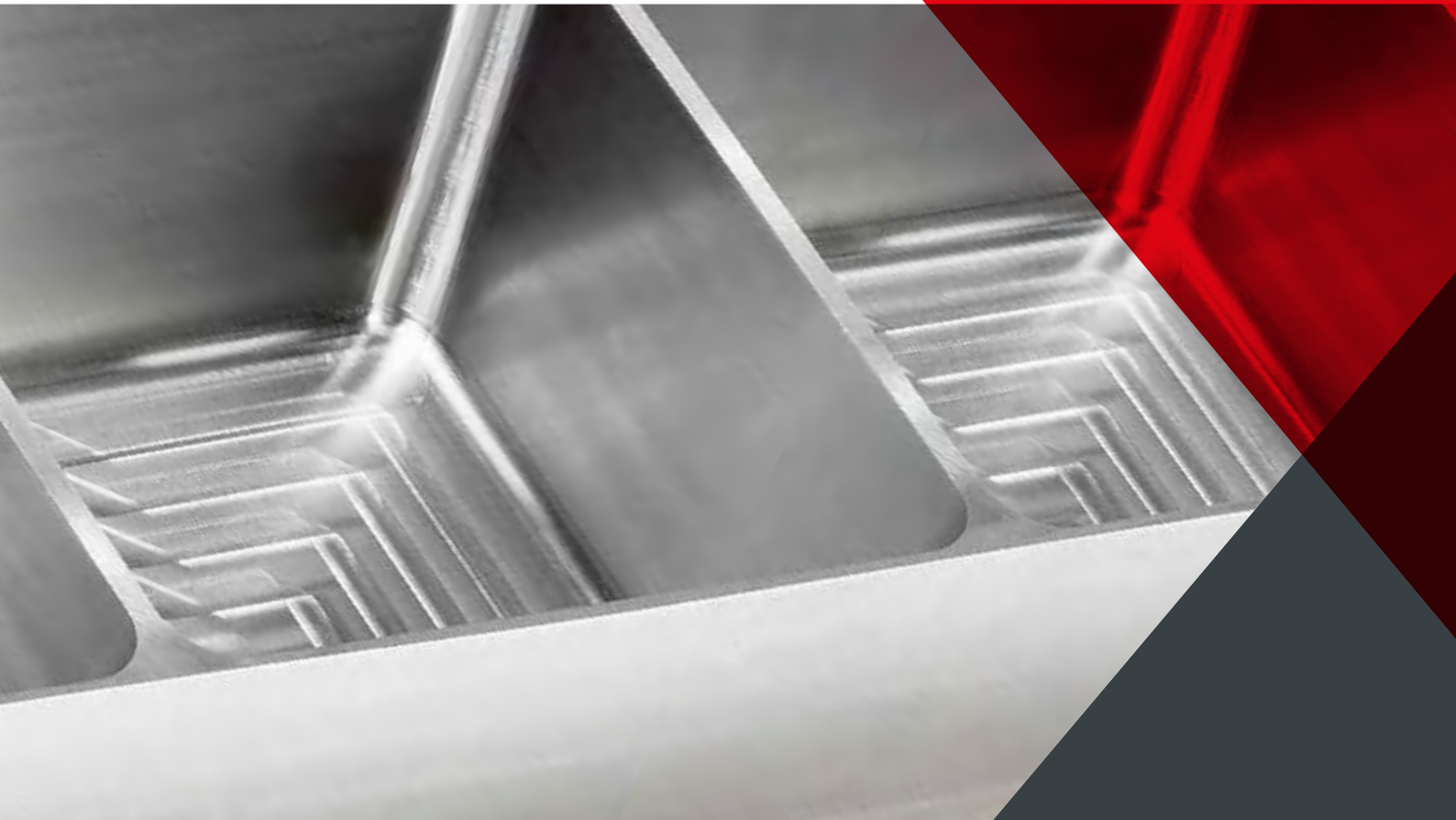


STC Series

The reference for precise 5-axis High Performance Cutting
Model version 2023/2024



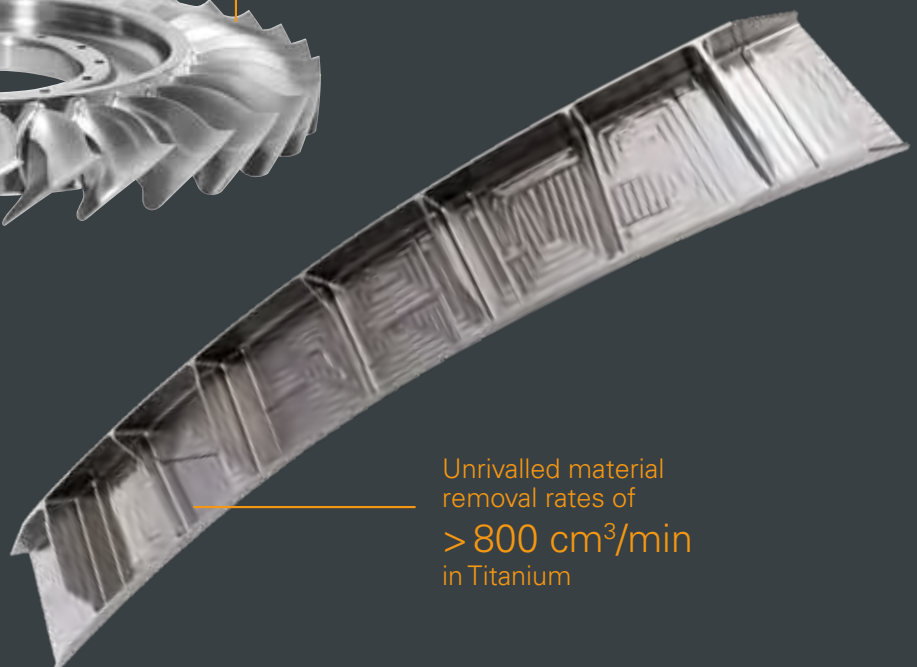
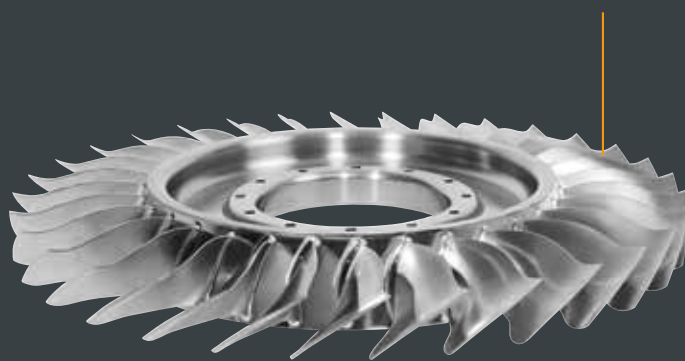
The best solution

Starrag has established an excellent reputation around the world as a technology partner with leading manufacturers of demanding work-pieces. Especially for its benchmark performance in challenging applications like machining structural aerospace parts, casings or airfoils, Starrag is the name the world uses.

This technology partnership includes everything from customer specific engineering to application development including CAM programming, tool and fixture design and automation.

Starrag offers comprehensive process know-how and for many years has successfully delivered complete turnkey projects. As a customer you benefit from leading manufacturing technology, flexible production support, individual user training and a global service.

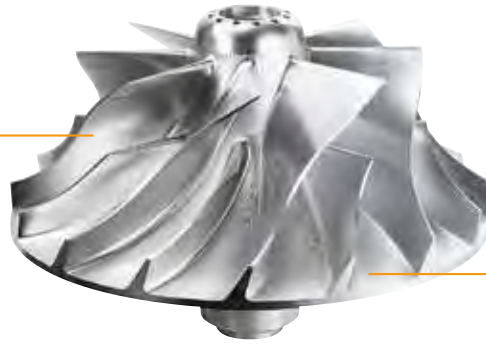
Reliable precision
and unblemished
surfaces for $R_a < 0.6\mu\text{m}$



Unrivalled material
removal rates of
 $> 800 \text{ cm}^3/\text{min}$
in Titanium

Customized solutions

for open and closed impellers



Increased process reliability
through complete turn-key solutions incl. technology, fixtures and tools

High performance cutting

STC machining centers are built for serious high performance cutting. The STC machine design started with the target of achieving highest material removal rates. All the machine parameters are set in order to achieve that. Difficult to cut materials like titanium alloys for example (Ti6AL4V, Ti5553), Nickel-based superalloys, or high alloyed steels as well as for high strength aluminum, best machining results are achieved on the STC.

The unique design of the machine series even makes 5-axis simultaneous roughing possible, allowing for an even stock material distribution before finishing.

Complex freeform machining

With the STC machines, superior surface finish can be achieved, fulfilling highest production requirements. If it is a complex part like a blisk, or a thin-walled structural parts, if it is machined using point or line contact, if finishing is done in 5-axis simultaneous mode or not, immaculate surfaces can be produced on the STC machining centers.

Consistently high accuracy

Consistent high quality in production – part after part, year after year. Starrag has been working hard to achieve highest accuracy not only once but consistently – greatly minimizing the effect of variable environment conditions and maintaining a constant high stability. With this, scrap can virtually be eliminated and the cost for expensive air conditioning can be reduced dramatically.

30% more productive
for hard metals like Titanium or Inconel



Starrag – Technological competence

Planning reliability, productivity and quality are the most decisive factors in the production of demanding workpieces. Starrag continuously strives to increase the real life process performance.

Productivity

Machine design and axis concept are critical for achieving process stability during roughing and high dynamics when finishing. Consequently, shorter process times with reduced tool wear are possible with the STC design.



In addition to the classical machine building methods for a design without weaknesses, a number of unique features increase the performance of the STC machines:

- The uniquely compact 1D-head (2D-head option) with its short distance between the spindle nose and A-axis makes it possible to use shorter tools due to its small collision contour.
- The unique Starrag steel-steel worm-wheel features highest stiffness with excellent damping for the A-axis drive – virtually wear free.
- A specially coated damping disk in the 1D-head makes heavy roughing in 5-axis operation possible.
- For hard-to-cut metals, the Starrag gear spindle dramatically increases stable depths of cut, due to the big spindle shaft diameter and the short bearing distance on the shaft.
- The releasable thrust bearing for the linear axis effectively doubles the stiffness of the drive chain in comparison to standard ball screw arrangements.



These features are proven to increase the process stability to unmatched levels, shown best by cutting trials where material removal rates over 800 cm³/min were achieved in Ti6Al4V. On the STC machines, the most productive tools and cutting strategies can be used to their fullest potential.



The NC control is an integral part of the machine. At Starrag, machine and control system are seen as one single unit.

This single unit philosophy has advantages, especially for finishing. Control behavior and NC path planning are developed and optimized in great detail to achieve the perfect combination of geometrical accuracy, surface quality and of course productivity. Depending on the required application, the machine can be optimally configured using five settings: roughing, pre-finishing, fast finishing, finishing and super finishing.

Starrag machines are built for machining. Non-productive times are systematically analyzed and eliminated, providing in-

creased productivity without generating additional costs.

In addition, Starrag also provides productive solutions specific for the requirements of machining thin-walled parts where the low stiffness of the work-piece means the cutting conditions are hard to stabilize.





Surface quality

Starrag's aim is to mill blemish free workpiece surfaces, giving you ready to assemble workpiece directly from the machine.

Any influence, which manifests itself as a defect in the workpiece's quality is systematically analyzed by Starrag, and the system is subsequently optimized. Whether it is the elimination of chatter or reversal marks, or perfecting the quality of the milling path generation, Starrag sets new standards with the STC machine range.

Some recent improvements introduced by Starrag:

- Disturbance free drive concepts
- Specific analysis of process stability
- Control optimization for cutter path planning
- Adaptive compensations
- Model-based feed-forward control

All these result in a new quality of surface finish.

Optimal process cooling

One key factor to lowering your tooling costs and increasing your productivity is selecting the right cooling method. All state-of-the-art through spindle cooling medias are available throughout the STC range.

- High pressure cooling for water-based coolants or oil (pressures up to 150 bar to get as close to the cutting zone as possible)
- Through spindle air
- Aerosol (minimum quantity lubrication)

Of course external cooling with coolant or CO₂ is possible too. With these options, breakthroughs in tool life are achievable, giving your largest saving on your tooling costs.



Precision / process capability

In modern production, quality is an absolute must. For Starrag this means that reliable manufacturing must be possible in less than ideal conditions such as fluctuating temperatures or lack of warm-up phases.

As the customer this is an opportunity to reduce costs by reducing the frequency of CMM measuring the finished parts. Additionally, energy costs for temperature stabilization of the shop and machine can be reduced.

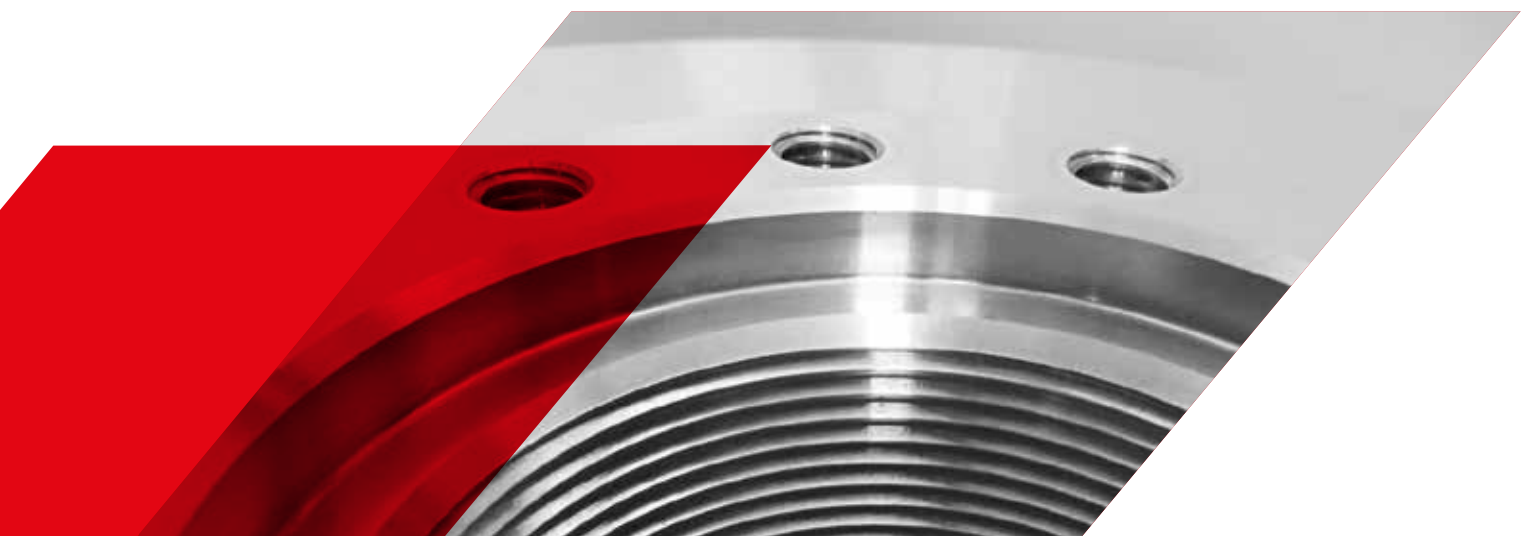


To achieve standard deviations of just a few microns on consecutive parts, a number of approaches are followed:

- The prerequisite is to have a basic mechanical design of the STC machines based on engineering principles. This includes symmetry, suitable cooling, efficient chip removal etc.
- Homogeneous temperature level in the machine is the basis for thermal stability. The temperature of the cooling agents is controlled to match the ambient temperature.
- Expansion of the spindle through thermal drift or centrifugal forces is constantly measured and compensated by direct measurement.
- The effects of machine displacements due to thermal drift can be corrected directly on the work-piece before the green button process starts.



With all of these measures a new level of process capability is achieved. Expensive scrap can be avoided. Subject to the application, external measuring operations are eliminated and air conditioning requirements reduced.



Starrag – Innovative solutions

New developments in different industries such as aerospace or energy create new challenges in manufacturing. Starrag's dedicated, innovative solutions make productivity leaps in modern production possible.

Adaptive machining

Productivity and accuracy are no longer just a question of machine and tool. Adaptive machining of the individual workpiece is a quantum leap for many applications.

The actual shape of the workpiece is captured on the machine using Starrag's own 5-axis measuring cycles.

The NC program can then be specifically adapted or created anew – reliably and fully automated. This technology provides advantages for a multitude of applications:

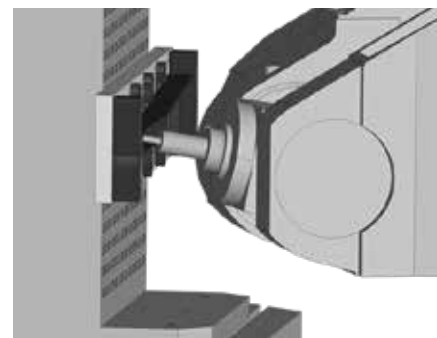
- Non machining time («air cut») on forged blanks can be eliminated
- The tolerances when machining with respect to pre-machined references can be tightened dramatically.
- Thermal drift of the machine can be detected and compensated automatically.

Adaptive machining is completely integrated and the process is fully automated. The potential of adaptive machining is best illustrated by Starrag's subsidiary TTL in their adaptive repair of turbine components.

CAM systems

Starrag covers the full process chain from part model to finished workpiece.

Starrag has expert knowledge in the leading CAM systems. With its own machine specific postprocessors the ideal interface to the machine control is provided, integrating all advanced machine functionality to make maximum use of the machine's capability.



Virtual machining

Virtual machining is a highly-developed simulation program for Starrag machining centers which enables users of CAM software to simulate, check and optimize complex manufacturing processes in full on a computer screen. With the integration of a «virtual» NC, the exact machine behavior and the exact run-time of programs can be determined beforehand.





STC 1000

Automation / FMS

For over 40 years Starrag has been acting as a main contractor designing and supplying linked FMS systems for the fully-automated manufacturing of complex parts across multiple machines. The STC machines can be integrated into a complete FMS with loading station, central tool handling, pallet transport and storage. Other operations and follow-up processes such as washing, measuring, labeling, deburring or grinding can of course be integrated into the FMS.

A combined system using both STC machines and other Starrag Group machines, like for example the 4-axis Heckert centers or the vertical Berthiez grinding centers, is another possibility here.

The complete manufacturing process is planned, steered, monitored and documented by user-friendly central computer software with integrated PPC (production planning and control). Each automation system is customer-specifically designed and delivered as a turn-key solution.

To ensure the required reliability for fully-automated and unmanned production in an FMS, the STC machines have been designed from the beginning to allow the best FMS integration including the various fixturing solutions necessary. The modular build-up also allows a gradual expansion of the system.



Starrag – Application focused

Aerostructures, Casings, Blisks and Impellers – the STC series is designed and built with these applications in mind. When starting with the application, breakthroughs in the achievable productivity and production safety become possible. Starrag has developed a multitude of unique and specific features providing real advantages over all general machine tool builders.

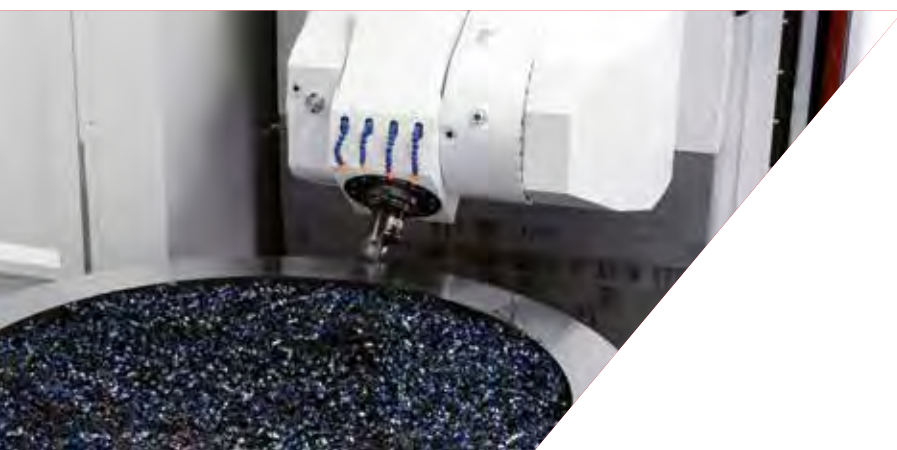


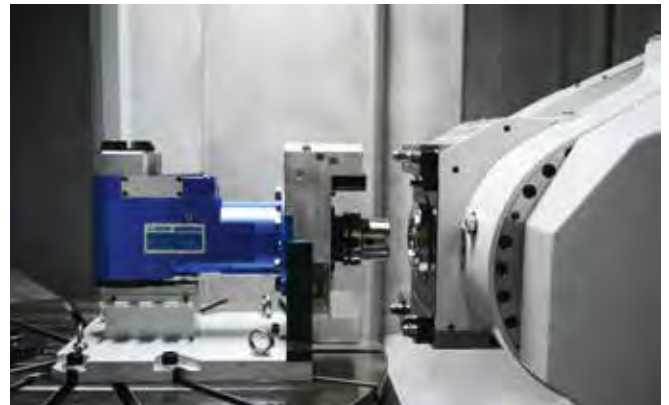
Turning functionality

All machines in the STC series are available with full turning capability. Free-form turning, specific measurement cycles etc. make complete and accurate machining a reality.

Best access with A/C head

An STC machine can be equipped with an A/C head – making it effectively a 6-axes machine. With this feature, the access to certain features – undercuts, internal surfaces, complex freeform surfaces – is improved. The benefit is clear: Shorter, more stable tools can be used, therefore drastically reducing tooling cost and improving production reliability. Furthermore, compensation motions of the linear axes can be reduced dramatically.





Angle head with automated tool change

For many applications, e. g. casings or gearboxes, angle heads are necessary to machine internal surfaces. Starrag provides the leading solution here. The machines can be equipped with angle heads. Not only can an angle head be loaded fully automatically from the tool magazine into the spindle, but also can the tools be changed automatically into the angle head. That means that a multitude of different cutting tools can be used with the same angle head – setting a benchmark for flexibility.

Starrag – Technology partner

To have the most efficient production running, every factor must be taken into account. Starrag strives to be a technological partner of its customers. In close collaboration a continuously improving productivity can be achieved.

Technology partnership

Precision and efficiency in production are dependent on the process expertise of the application engineer.

To continuously improve productivity, Starrag is constantly very active in the field of process development. Newly developed milling cycles and tools allow the process time to be significantly reduced. To be able to use the new machines to their full potential, the process is analyzed in great detail and the optimization potential is evaluated. Strategies, tools, cutting conditions and fixtures are constantly evaluated and improved by Starrag.

Starrag strives to work closely together with its customers so that they can benefit from these innovations.

Within such a partnership, Starrag can contribute in different fields:

› **Process development and optimization:** Machining technology can be developed according to the latest state-of-the-art specifically according to the individual requirements of the customer.

› **Process analysis:** In depth analysis can be made for challenging applications to come to optimal solutions, e. g. FEM analysis and tool geometry optimization, NC path analysis for cutting path geometry optimization.

› **Fixture design:** Optimized fixtures can be provided that allow for highest cutting stability and lowest distortion of the workpiece, no matter if they are for blanks or forgings.

› **Machine upgrades:** Starrag wants customers to take advantage of the continuous progress made at Starrag for existing machines. Control and mechanical upgrades are on offer that allow existing STC machines to become more productive.

With Starrag, continuous productivity improvement can be made even with existing machines. With such a technological collaboration the competitiveness can be constantly increased.

These customer-specific improvements are effective, target-oriented and cost transparent.





Innovative fixturing concepts

The special workpiece geometries create specific demands on the clamping fixtures. Starrag has in-house specialists who develop individual clamping concepts to meet the specific requirements of the individual workpiece.

Starrag offers the following advantages:

- Part optimized fixturing for both efficient roughing and distortion free finishing.
- Mechanical, pneumatic, hydraulic or vacuum clamping solutions can be implemented.
- Media ports are accessible directly on the pallet.
- Media clamping solutions can be included into flexible manufacturing systems.

Zero positions of multiple fixtures can be stored in the control system. Measuring of blank positions can therefore often be eliminated.

Aerospace and Turbine Competence Center

In the ATCC (Aerospace and Turbine Competence Center) facility new and demanding machining processes are tested and optimized and small and one-off series are produced. In the ATCC customer specific processes can be optimized. For existing customers, there is also the possibility to use the ATCC for contract manufacturing to provide a solution for coping with peak loads.

The most modern 5-axis machining centers are available for producing complex workpieces, ranging from the heavy duty milling of titanium alloys to high-speed machining of light metals.



—
STC 800/130



—
STC 1250/150

The right tools for getting parts right

Highest flexibility, benchmark quality – this is what Starrag cutting tools sets apart

Specific applications require specific tools. For any batch size, Starrag is an experienced and flexible partner to provide custom-made tools quickly and reliably.

With the specific applications in mind, carbide grades, specific contours, angles and radii are selected. For stable machining of instable workpieces, Starrag designs and provides part-specific tooling that significantly increases your productivity and lowers your cost per part.

Starrag works directly with the end-user to deliver the best tools for your parts, and you profit from the expert knowledge of our application engineers who deliver complete turnkey solutions for productivity breakthroughs.

In Starrag's unique «Aerospace and Turbine Competence Center», we machine turbine and aero structure parts under benchmark conditions.

Customer-specific tool solutions

Starrag designs and produces milling tools based on the requirements for your specific parts. Your components are machined using innovative solid carbide milling tools produced the highest quality for aluminum, steel, titanium, and nickel-based material applications.



Global reconditioning service with Oerlikon Balzers

Additionally to regrinding worn tools in its facility in Switzerland, Starrag has partnered up with the global leader for coatings – Oerlikon Balzers. Oerlikon Balzers uses the original grinding processes from Starrag, applying the same coating as on the original tool.

With this partnership, you save on inventory and receive OEM grinding standards globally in short lead times.

We can offer professional reconditioning services in:

- › **Switzerland** Rorschacherberg
- › **Austria** Stainz
- › **Romania** Maracineni (Pitești)
- › **Turkey** Bursa
- › **Argentina** Buenos Aires
- › **Mexico** Querétaro, Saltillo
- › **China** Chengdu, Suzhou
- › **India** Ahmedabad, Aurangabad, Bangalore, Changdigarh, Chennai, Jamshedpur, Manesar, Pune
- › **Korea** Pyeongtaek, Busan
- › **Philippines** Calamba City
- › **Thailand** Chonburi

oerlikon
balzers



Find your local regrinding support center.



The STC machine range

The machining solution from the pioneers of 5-axis milling



—
STC 800



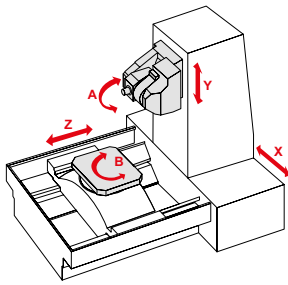
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STC 1250

Efficient high performance machining requires a rugged machine build-up without weakness. All technical parameters such as axis strokes, forces, torques and accelerations are set according to application requirements. The design of the STC series has no bottleneck reducing the maximum possible material removal rates (like motor spindles with slender shafts, long quills). With its design, unmatched productivity is possible. Of course all the machine parameters for efficient production are set for the task:

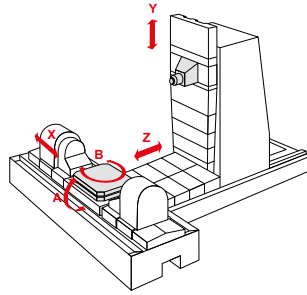
- Application oriented spindle selection: From a 1,600 Nm S1 gear spindle for heavy titanium roughing to a 80 kW 18,000 rpm motor spindle for high performance aluminum milling, the perfect spindle for each application is available.
- High pressure cooling of up to 150 bar leads to improved heat extraction in the cutting zone and therefore longer tool lives.
- Benchmark thermal stabilization and self calibration allow zero scrap rate machining with highest process capabilities.
- Ground level assembly reduces the investment in the shop, increases flexibility and reduces installation time.
- Modular build-up with 1D-head, 2D-head (Version 170) or trunnion (Version 150) provides the optimal configuration for the individual application.

The STC machine enhancement is ever ongoing. The goal is to continuously increase the customer benefits, i. e. increase productivity, increase accuracy or expand the application options.

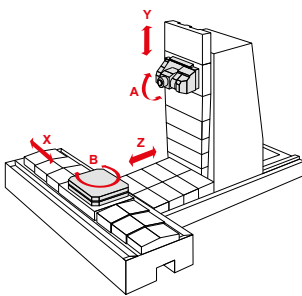
Axis configuration diagram



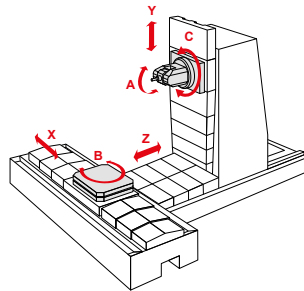
STC 800



STC 1250/150



STC 1000-1800



STC 1250-1800/170

Axis concept

24hrs / 7 days a week high performance cutting. That is what the STC machines are designed for. The horizontal spindle configuration enables optimal chip flow. To achieve highest material removal rates, it is decisive to have a balanced design without weakness. Here the extremely compact milling heads (1D or 2D head) are built stiff and accurate. In addition to the high stiffness, the compact milling head, means shorter tools can be used giving additional stability. The STC machines are built up from modules, sharing many with the Starrag BTP machines for large titanium parts. With this modular concept, a multitude of variations are possible to easily adapt the machine to individual customer requirements. The modules are field proven and well tested, guaranteeing the highest machine reliability while allowing a systematic continuous increase in machine performance.

Application specific design

The modular design of the STCs allows selecting the optimal configuration for the specific application. While in most cases the well established 1D nodding head is optimal, where as a 2D head (A- and C-axis combination) is beneficial for example for large structural aerospace components or large multi blade parts such as impellers. For engine casings, or complex gearboxes where a trunnion configuration may be better suited, Starrag offers the STC 1250/150. Which can be combined with a quill or HV head, depending on your application needs.

Machine intelligence

Intelligent systems can today significantly increase the productivity and availability of machine tools.

The STC machines are at the cutting edge in this field:

- Process analysis and stability evaluations can be made easily with integrated sensors and evaluation routines.
- Collision damage is significantly reduced thanks to rapid crash detection and machine stop. This is an excellent addition to Starrag's simulation solutions to avoid expensive machine downtime.
- The imbalance of all tools and the state of the spindle bearings are automatically monitored.

The STC machines use a multitude of Starrag's own cycles for automatically achieving improved milling results. Specific Starrag HMI functionality makes the operation and fault analysis of STC machines easy. The technical availability of the machine can also be directly detected and evaluated. Energy efficient manufacturing technology of the STC series pays off and save costs.



Tool handling

The STC machines are equipped with state-of-the-art tool magazines and tool changers manufactured by the Starrag Group.

With a range of tool magazines from 60 to 510 tools (HSK-A100 / ISO 50 / HSK-A63), the right solution can be selected for any application.

Starrag's chain and tower magazines offer the following advantages:

- Fast and reliable design, tested in hundreds of machines.
- Tool loading during machining process.
- Wide variety of magazine sizes and options.

Starrag tool magazines offer features like; tool beakage detection, tool coding, FMS automated tool handling automated loading of tools into angle heads can also be realized. Regardless of the applications, Starrag offers the right solution for the job.



Tool handling		Chain	Tower
Tool taper		HSK-A100 / ISO 50 / HSK-A63	HSK-A100 / ISO 50 / HSK-A63
Number of tool locations		60 (80 / 120)	180 up to 510
Max. tool ø (full occupancy)	mm	125	110
Max. tool ø (free adjacent pockets)	mm	250	250
Max ø Bridging tools	mm	500	500
Max. tool length, standard	mm	450	450
Max. tool weight	kg	15	15
Max. tilting moment	Nm	15	15



Swarf Management

- Twin swarf conveyors in the longitudinal bed
- Generous swarf openings and angled areas
- Integrated washing system with workpiece shower
- Suited for either wet or dry machining



Super rigid gear spindles

- For hard to cut materials Starrag gear spindles achieve higher material removal rates through
- Superior stiffness with short and sturdy spindles shafts
 - Superior collision contour through compact built up means shorter tools lengths
 - Superior torque characteristic adjusted for hard metal machining

Service: Expertise and Availability

Machines from the Starrag Group are known for their extremely high levels of productivity and precision. In order for a customer to achieve a rapid return on investment, a high level of availability and working in three-shift operation must be assured at all production sites.



A further factor for reliably high availability numbers is preventative maintenance tailored to the operating conditions and production requirements. With the aid of condition monitoring along with planned component inspections, consistently high availability rates are achieved, and unplanned downtime is reduced to a minimum.

Retrofits and upgrades ensure that machines are brought fully up to date regarding technology, and are adapted to meet new requirements. This safeguards the machine's value and extends its life cycle.

With these service products Starrag can guarantee machine availabilities. Starrag is fully transparent so that the total cost of ownership (full life cycle cost) can be calculated in detail.

Key benefits:

- Planning reliability due to guaranteed uptimes
- Optimized life cycle costs
- Sustained machine value

With its 300 employees, the Starrag Group's global service network is specifically set up to meet these requirements. The range of services offered covers everything from the supply of spare parts, a repair service, to guaranteed availability and optimized life cycle costs. Together with the customer, our service experts draw up individually tailored service solutions, and offer advice as they are implemented.

Every incident is dealt quickly with the 24/7 hotline support, remote diagnostic tools, a local network of technicians close to the customer, and a global spare parts supply service through regional hubs.

Qualified operating and maintenance staff are important key factors in maintaining a high level of plant availability. This is why the Starrag Group offers comprehensive training programmes in the relevant language, both at its training centers at its own plants, and at the customer's own site.



On-site around the world

Europe

Benelux / Denmark / Germany / Finland
France / United Kingdom / Italy / Austria
Poland / Sweden / Switzerland Slovakia /
Spain / Czech Republic / Belarus

Middle East

Israel / Turkey

Americas

USA / Canada / Mexico / Brazil

Asia

China / India / Indonesia / Japan / Korea
Malaysia / Singapore / Thailand / Taiwan

Oceania

Australia / New Zealand

Africa

Egypt / South Africa



Technical Data

		STC 800	STC 1000	STC 1250	
Pallets					
Pallet clamping surface according to DIN 55201	mm	800 x 800 (800 x 1,000) Ø 1,000	800 x 800 (800 x 1,000 / 1,000 x 1,000) Ø 1,400	1,000 x 1,000 (1,000 x 1,250 / 1,250 x 1,250) Ø 1,600	
Max. workpiece weight	kg	2,000 (2,500)	3,000	5,000	
Working area					
Column linear travel X	mm	1,450	1,700	2,200	
Main spindle vertical travel Y	mm	1,200	1,600 (1,900)	1,500 (1,900)	
Table traverse travel Z	mm	1,320	1,950	2,100	
Swing diameter	mm	1,400	1,700	2,200	
A-axis	degrees	-120 / +60	-120 / +60	-120 / +60	
B-axis	degrees	endless	endless	endless	
C-axis (.../170)	degrees	-	-	(360)	
Feed rate/Rapid traverse rate					
X/Y/Z	m/min	60	45	45	
A-axis	rpm	6 (12)	6 (12)	6 (12)	
B-axis	rpm	60	20	20	
B-axis (MT, with turning capability)	rpm	500	500	400	
C-axis (.../170)	-	-	-	(14)	
Main spindle					
Gear driven spindle, max. speed	rpm	5,600	5,600	5,600	
Max. power at 100% duty cycle	kW/Nm	37 (53) / 1300	37 (53) / 1300	37 (53) / 1300	
Tool taper		HSK-A100 (SK 50)	HSK-A100 (SK 50)	HSK-A100 (SK 50)	
Gear driven spindle, max. speed	rpm	8,000	8,000	8,000	
Max. power at 100% duty cycle	kW/Nm	37 (53) / 940	37 (53) / 940	37 (53) / 940	
Tool taper		SK 50 (HSK-A100/HSK-T100)	SK 50 (HSK-A100/HSK-T100)	SK 50 (HSK-A100/HSK-T100)	
Gear driven spindle, max. speed	rpm	12,000	12,000	12,000	
Max. power at 100% duty cycle	kW/Nm	37 (53) / 620	37 (53) / 620	37 (53) / 620	
Tool taper		HSK-A100 (HSK-T100)	HSK-A100 (HSK-T100)	HSK-A100 (HSK-T100)	
Motor spindle 1, max. speed	rpm	18,000	18,000	18,000	
Max. power at 100% duty cycle	kW/Nm	80 / 250	80 / 250	80 / 250	
Tool taper		HSK-A100 (HSK-T100)	HSK-A100 (HSK-T100)	HSK-A100 (HSK-T100)	
Positioning accuracy according to VDI/DQG-3441					
		Axes X/Y/Z	Axes A/B/C	Axes X/Y/Z	Axes A/B/C
Positioning uncertainty (P)		0.006 mm	6 sec	0.006 mm	6 sec
Positioning scatter (Ps)		0.0028 mm	4 sec	0.0028 mm	4 sec
Reversal error (U)		0.002 mm	3 sec	0.002 mm	3 sec
Dimensions and weight					
Weight	t	31	42	58	
Space requirement for basic machine LxWxH	mm	8,930 x 5,410 x 4,520	9,500 x 7,800 x 4,550	11,400 x 8,300 x 5,450	
CNC Control					
		Siemens	Siemens	Siemens	

MT: Machine with turning table

/150: Trunnion

/170: A/C Head

Values in brackets = option

STC 1250/150		STC 1600		STC 1800	
1,000 x 1,000 (1,000 x 1,250) Ø 1,600		1,250 x 1,250 (1,250 x 1,600 / 1600 x 1600) Ø 2,000		1,250 x 1,800 (1,600 x 1,800) Ø 2,500	
3,000		8,000		12,000	
1,950		2,800		3,400	
2,000		1,900		1,900	
2,100		2,450		2,850	
1,950		2,800		3,300	
-50 / +95 (or according to customer requirements)		-120 / +60		-120 / +60	
endless		endless		endless	
-		(360)		(360)	
40		40		40	
5		6 (12)		6 (12)	
5.5		20		20	
-		300		290	
-		(14)		(14)	
6,000		5,600		5,600	
37 (53) / 1,235		37 (53) / 1300		37 (53) / 1300	
SK 50 (HSK-A100)		HSK-A100 (SK 50)		HSK-A100 (SK 50)	
-		8,000		8,000	
-		37 (53) / 940		37 (53) / 940	
-		SK 50 (HSK-A100/HSK-T100)		SK 50 (HSK-A100/HSK-T100)	
-		12,000		12,000	
-		37 (53) / 620		37 (53) / 620	
-		HSK-A100 (HSK-T100)		HSK-A100 (HSK-T100)	
-		18,000		18,000	
-		80 / 250		80 / 250	
-		HSK-A100 (HSK-T100)		HSK-A100 (HSK-T100)	
Axes X/Y/Z	Axes A/B/C	Axes X/Y/Z	Axes A/B/C	Axes X/Y/Z	Axes A/B/C
0.006 mm	6 sec	0.006 mm	6 sec	0.006 mm	6 sec
0.0028 mm	4 sec	0.0028 mm	4 sec	0.0028 mm	4 sec
0.002 mm	3 sec	0.002 mm	3 sec	0.002 mm	3 sec
75		63		67	
14,300 x 10,200 x 5,450		14,500 x 10,200 x 5,450		14,950 x 10,290 x 5,450	
Siemens		Siemens		Siemens	

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