

**starrag**

Engineering precisely what you value

Tool solutions  
2018/2019



# The right tools for YOUR parts

Highest flexibility, benchmark quality – that is what Starrag sets apart.

To make specific tools for your application, for any batch size, you need a partner with a lot of experience and a flexible organization; here in Starrag we have both these qualities, and we pride ourselves on helping our customers.

With your specific application in mind, we select carbide grades, specific contours, angles and radii. For stable machining of instable work-pieces, Starrag designs and provides part-specific tooling that significantly increases your productivity and lowers your cost per part.

Starrag works with you 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 «Center of Production Excellence», we machine turbine and aero structure parts under benchmark conditions.





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# Research and development

Leading turnkey solutions for turbine and aerostructure parts.

**There is the potential to optimize every milling process with a combination of application specific milling tools, newly developed milling cycles and processing strategies.**

We constantly strive to reduce your component costs. At Starrag, we use this holistic approach, applied throughout the entire production process to find its potential.

In close cooperation with technologists, tool designers, manufacturers of cutting inserts and clamping devices, we carry out extensive test-runs, continuously monitoring these influences

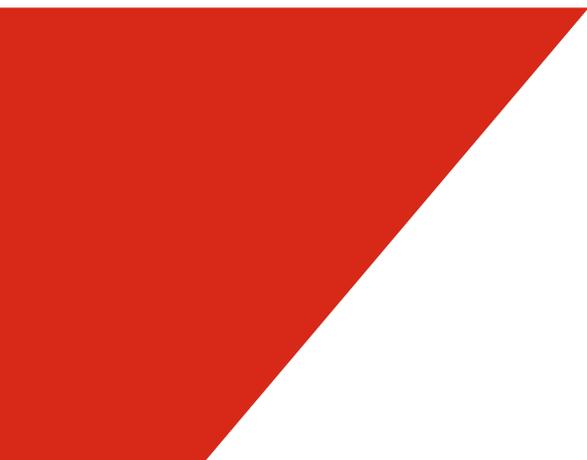
to analyze and assess the optimization capability. This culture of continual advancement, coupled with our in-house software developers who, often in intensive cooperation with universities, develop new milling cycles, we have all the tools required to develop and test processes to achieve the highest possible performance for your benefit.

One of our main strengths is the specialized design of production tools for a particular milling process.

We manufacture tools in accordance with your individual specification and with short lead times.

**Key benefits:**

- Reduce cost per part through optimized tools
- Better (improved) surface quality and longer tool life
- Complete process development from one source



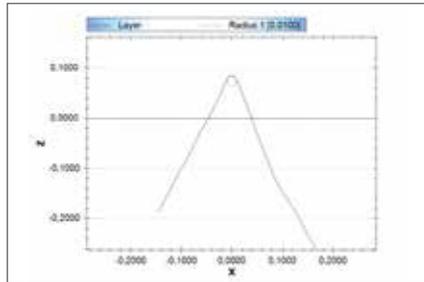
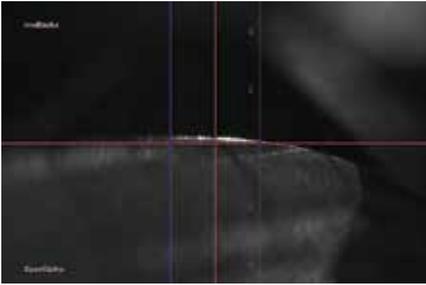


# Superior Quality and Performance

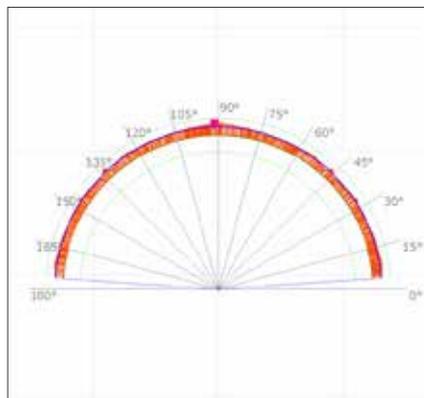
## At the Cutting Edge

The cutting edge geometry is one of many parameters when designing a high performance tool. For applications like turbine blades and blisk machining, where thin edges are commonplace, the micro shape of the cutting edge becomes increasingly important. In order to take tool performance to the next level, the nano geometry has a macro effect.

With over half a century of application know-how, Starrag knows exactly the kind of cutting edge preparation is required for your workpiece. We always produce the best cutting edge, and monitor its quality with our extensive quality control equipment.



## Production Safety



Nothing is more important than production safety. Even the best tool has no value if you can't rely on its performance. At Starrag we understand that you need your machines producing good parts, without interruption, 24/7. To ensure this level of safety we run a dedicated quality program, so that each tool has a reliable life time and geometrical accuracy. Our quality control and statistical process control schemes make sure this is one thing less on your mind.

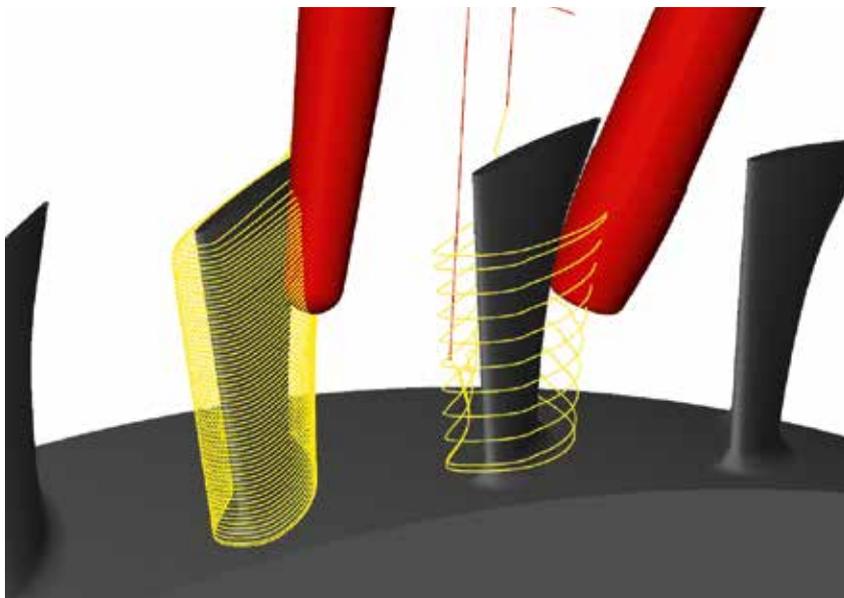
## Tolerances as Requested

Step	Result	Mod.	Nom. value	U. tol.	L. tol.	Act. value	Diff. value	New	Tolerance
2	Radius contour	Ra	1.000	0.025	-0.025	0.984	-0.016		
2	Circle center Z	CZ	-1.000	0.025	-0.025	-0.984	0.016		
2	Circle center X	CX	0.000	0.025	-0.025	-0.002	-0.002		
3	Radius	Ra	1.000	0.025	-0.025	0.982	-0.018		
3	Inclination	NW	6.00	0.10	-0.10	5.98	-0.02		
4	Crossways dimension X	DA	1.989	0.050	-0.050	1.956	-0.033		
5	Crossways dimension X	DA	5.900	0.050	-0.050	5.862	-0.038		
6	Radial run-out	RRO	0.000	0.010		0.002	0.002		

Class	d1	R	d2	d3-5	l1	l2	l3-5	FL*	Radial run-out
S	+/-0.05	+/-0.025	h6	+/-0.1	+1/-2	0/+2	+/-1	+/-0.1	0.01
XL	+/-0.1	+/-0.05	h6	+/-0.2	+2/-4	0/+4	+/-2	+/-0.1	0.02
P	+/-0.025	+/-0.013	h5	+/-0.1	+1/-2	0/+2	+/-1	+/-0.05	0.005
C1									
C2									
C3									

Tolerances of modern parts have become increasingly tight. In order to meet the quality requirements of your components, everything needs to be in perfect condition. The cutting tool is no exception. We offer different tolerance classes in order to give you the right tool for your needs. The only thing you have to do is select the required tolerance class.

## New Generation of Cutters



An extensive know-how exchange between our application and tool engineering departments, makes sure that we are always at the cutting edge of the tool design. The research and development of our tools is improved with every part that our application engineers manufacture. They always strive for the most efficient production methods. As a result new generations of cutter geometries are created; from torus cutters, to barrel- and barrel ball nose cutters. Each of these designs undergoes extensive cutting trials on Starrag's high performance machines before being released to the market. Giving you the highest performance, quality, and safety for your production.



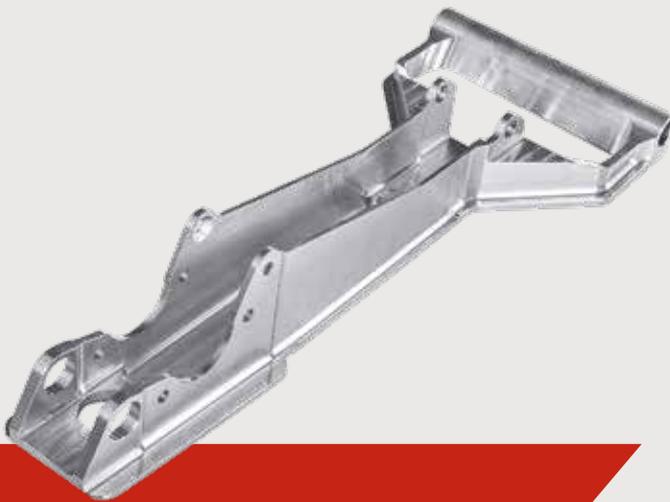
Impellers



Blisks



Blades



Aerostructures

# Customer-specific tool solutions

Optimally designed tools increase your productivity.

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.

Starrag offers large Solid Carbide and HSS monoblock ball nose cutters with MK and SK (ISO) shafts.

Please contact Starrag for customer specific solutions.



# Technology development and contract manufacturing

Profit from Starrag's experience and capacity.

To achieve the cost efficient process, a multitude of factors are decisive: machine, fixture, programming, coolant supply etc. Improvements are continually made in all of these areas. Starrag develops complete processes achieving the most cost efficient solutions. This way, productivity increases are transferable to existing machines.

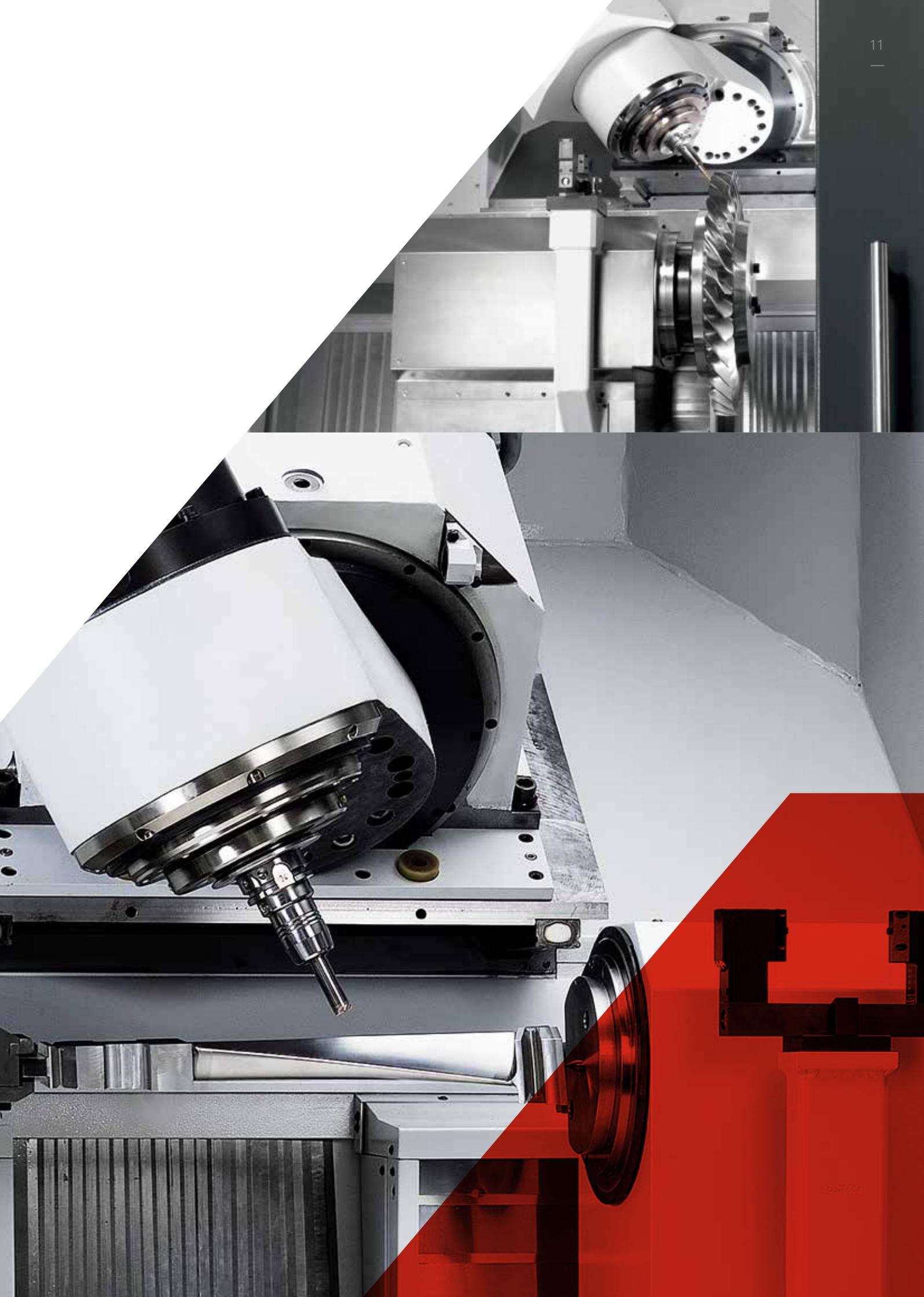
In Starrag's unique Center of Production Excellence (CPE), state of the art machines are available for turbine and aero structure machining and technology development.

As a flexible supplier to cope with your peak loads, the machines are run in shift operation for contract manufacturing. With Starrag as a strategic partner everything is possible.

## Key benefits:

- Increase your productivity with state-of-the-art technology
- Pilot lots and small batches cost-effectively produced
- The ability to accommodate seasonal peaks without machine investment
- Reduced ramp-up time for machine investments

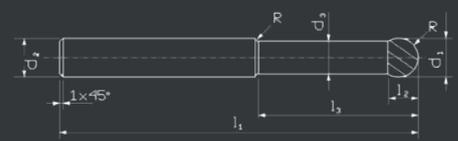
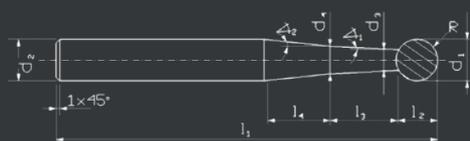
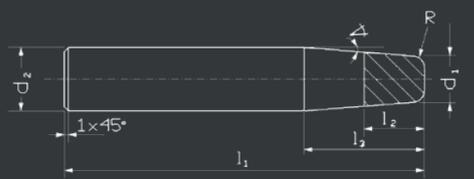
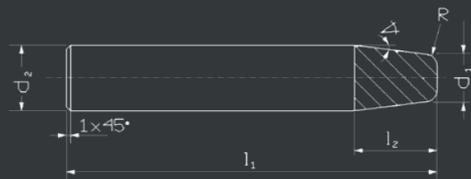
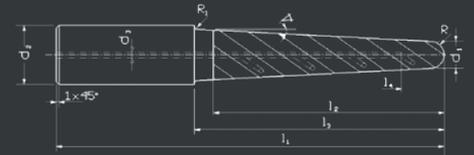
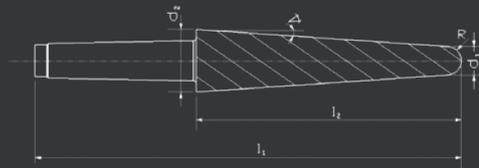




# Tools for Radial Compressors/Impeller

Dedicated solutions for open and closed Impellers.

Roughing, semi-finishing tool  
with chip breakers



Starrag offers the biggest choice of tools specific for Impeller machining. For flank milling open Impeller airfoils in one go, taper ball nose cutters up to 50mm in diameter and 600mm in length are available with or without chip breakers. For every Impeller – from car

turbo chargers to the largest steel or Titanium types for large compressors – Starrag has the optimal solution.

Torus cutters designed specifically for the task achieve the most efficient material removal rates.

For closed impellers it is important to have good access to all areas. Starrag offers special tools like «lollipop» cutters with optimum collision free contours. Like all Starrag tools, they are designed specifically to fit your part requirements.

## Note

Standard: coated, also available raw. Other cutter dimensions and coatings are available on request. Available also as **Duo-Lock™**

## Taper ball nose cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-3</sub>	angle	z
mm	2 -40	1-20	6-50	50-33t0	var.	var.	2-6
inch	0.08-1.6	0.04-0.8	¼ - 2	2-13	var.	var.	2-6

**Material:** Solid carbide/HSS

## Torus cutters for roughing

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-3</sub>	angle	z
mm	4-40	var.	6-50	50-330	var.	var.	3-6
inch	0.16-1.6	var.	¼ - 2	2-13	var.	var.	3-6

**Material:** Solid carbide

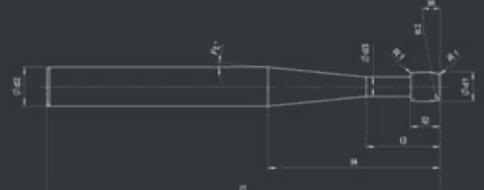
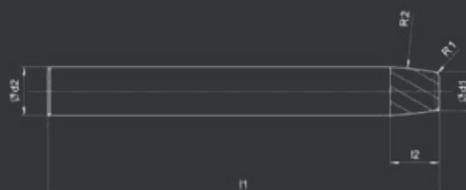
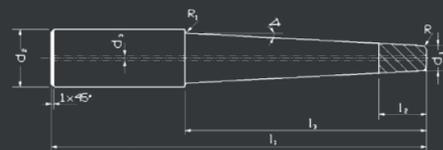
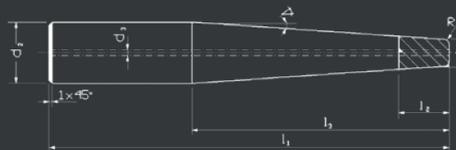
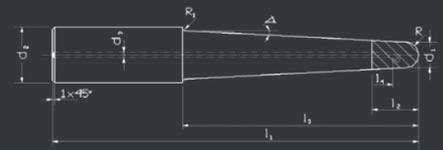
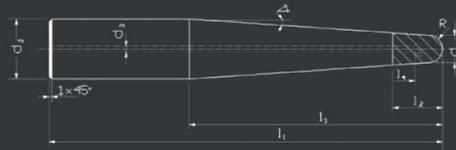
## Lollipop cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-4</sub>	d <sub>3-4</sub>	angle	z
mm	4-25	2-12.5	6-25	50-330	var.	var.	var.	4-8
inch	0.16-1.0	0.08-0.5	¼ - 1	2-13	var.	var.	var.	4-8

**Material:** Solid carbide

# Tools for Blisks/IBRs

Chatter free airfoil machining.



Efficient and chatter free finishing of Blisks or IBRs is one of the most difficult tasks in machining.

For such challenging components, Starrag has developed special tools

for point milling. The product range starts with taper ball nose cutters that provide good access to the part.

Starrag also developed special geometries like the torus and barrel cutter to

reduce cutting pressure on the airfoil flank. To reduce workpiece regenerative excitation that leads to chatter, Starrag also delivers variable pitch cutters. With the help of in-house testing, such tools can be adjusted ideally to your specific part.

## Note

Standard: coated, also available raw. Other cutter dimensions and coatings are available on request. Available also as **Duo-Lock™**

## Taper ball nose cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-3</sub>	angle	z
mm	4-20	2-10	6-32	50-330	var.	var.	2-6
inch	0.16-0.8	0.08-0.4	¼ - 1¼	2-13	var.	var.	2-6

**Material:** Solid carbide

## Torus cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-3</sub>	angle	z
mm	4-20	var.	6-32	50-330	var.	var.	4-14
inch	0.16-0.8	var.	¼ - 1¼	2-13	var.	var.	4-14

**Material:** Solid carbide

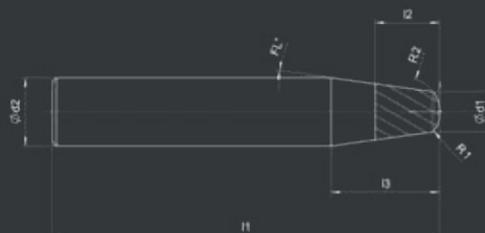
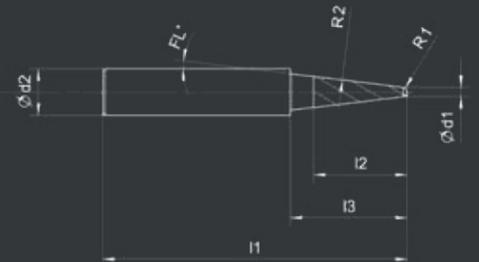
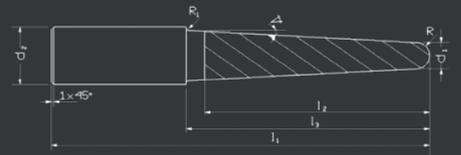
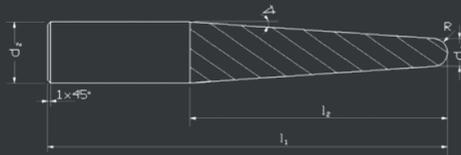
## Barrel cutters

units	d <sub>1</sub>	R <sub>1</sub>	R <sub>2</sub>	d <sub>2</sub>	d <sub>3</sub>	l <sub>1</sub>	l <sub>2-4</sub>	angle	z
mm	4-30	var.	var.	6-32	var.	50-330	var.	var.	2-6
inch	0.16-1.2	var.	var.	¼ - 1¼	var.	2-13	var.	var.	2-6

**Material:** Solid carbide

# Tools for Turbine blades

The most efficient choice for blade machining.



Productive machining for complex freeform shapes requires special tools. For airfoils, Starrag's wide selection of torus cutters with their custom shape and high number of teeth are ideal for fast and efficient 5-axis milling.

Starrag offers tapered ball nose cutters that can be used both for point milling on intersections and flank milling on platforms.

Variable pitch versions are also available for thin walled blades typically used in aero engines and gas turbines.

## Note

Standard: coated, also available raw. Other cutter dimensions and coatings are available on request. Available also as **Duo-Lock™**

## Taper ball nose cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-3</sub>	angle	z
mm	2-25	1-12.5	6-32	50-330	var.	var.	2-6
inch	0.08-1.0	0.04-0.5	¼ - 1¼	2-13	var.	var.	2-6

**Material:** Solid carbide

## Barrel ball nose cutters

units	d <sub>1</sub>	R <sub>1</sub>	R <sub>2</sub>	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-4</sub>	angle	z
mm	2-25	1-12.5	var.	6-32	50-330	var.	var.	2-6
inch	0.08-1.0	0.08-0.4	var.	¼ - 1¼	2-13	var.	var.	2-6

**Material:** Solid carbide

## Torus cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	angle	z
mm	5-30	var.	6-32	50-330	var.	4-14
inch	0.2-1.2	var.	¼ - 1¼	2-13	var.	4-14

**Material:** Solid carbide

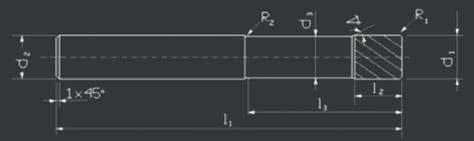
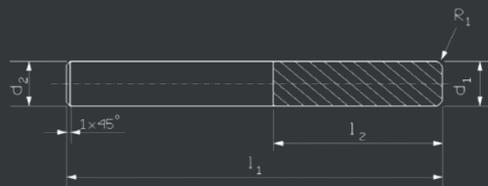
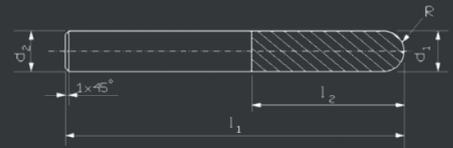
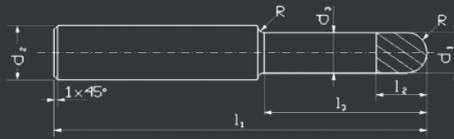
## Convex torus cutters

units	d <sub>1</sub>	R <sub>1</sub>	R <sub>2</sub>	d <sub>2</sub>	l <sub>1</sub>	angle	z
mm	5-30	var.	var.	6-32	50-330	var.	4-14
inch	0.2-1.2	var.	var.	¼ - 1¼	2-13	var.	4-14

**Material:** Solid carbide

# Tools for aerostructures

Higher productivity through part specific tools.



Standard tools are not always sufficient for efficient operations. On the one hand, Starrag can provide special macro geometries on diameters, radii, taper angles for

- Tapered ball nose cutters
- End mill cutters
- Cylindrical ball nose cutters to ideally fit your special part geometries.

On the other hand, with the trend to more thin-walled and delicate parts, Starrag provides tools with special macro geometries to reduce cutting pressure and/or with variable pitch cutting edges to reduce dynamic excitation. Starrag can always help to design such a tool when provided with the 3D part model from your specific application.

## Note

Standard: coated, also available raw. Other cutter dimensions and coatings are available on request. Available also as **Duo-Lock™**

## Cylindrical ball nose cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-3</sub>	angle	z
mm	6-32	3-16	6-32	50-330	var.	var.	2-6
inch	0.25-1.25	0.125-0.625	¼ - 1¼	2-13	var.	var.	2-6

**Material:** Solid carbide

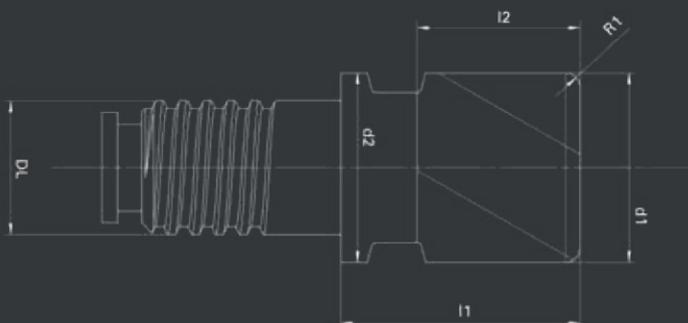
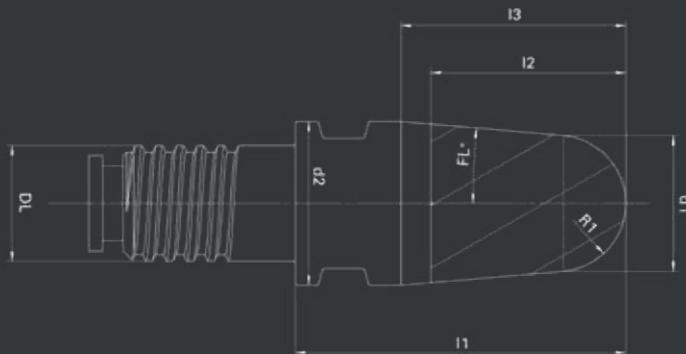
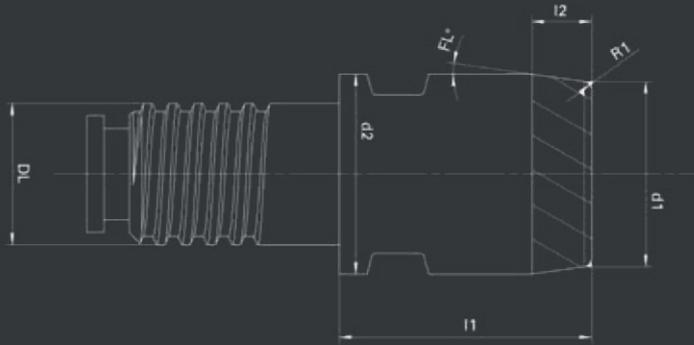
## End mill cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>1</sub>	l <sub>2-3</sub>	z
mm	6-32	var.	6-32	50-330	var.	2-10
inch	0.25-1.25	var.	¼ - 1¼	2-13	var.	2-10

**Material:** Solid carbide

# Duo-Lock™ (by HAIMER)

Advanced Materials Require Advanced Manufacturing.



The continuing development of high-strength, lightweight materials such as titanium alloys, Inconel, and new aluminium alloys are eagerly sought by manufacturers in many industries, including aerospace and defense, energy, and transportation.

These new materials present significant machining challenges in themselves. Add the competitive pressures in these global industries, and finding advanced manufacturing solutions becomes a top priority.

The Duo-Lock™ technology addresses the issue of the increasing cost of carbide by delivering a modular interface for cutting tool heads. Duo-Lock™ provides maximum stability and load capacity through a proprietary thread design with a double cone bond. The results are unmatched precision and productivity, with a connection that is virtually unbreakable in the most demanding applications.

## Torus cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>2 short</sub>	l <sub>2 long</sub>	l <sub>3</sub>	angle	z	DL
mm	8-30	var.	10-32	12.5-40	20-64	var.	var.	4-14	10-32

**Material:** Solid carbide

## Ball nose cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>2 short</sub>	l <sub>2 long</sub>	l <sub>3</sub>	angle	z	DL
mm	2-30	1-15	10-32	12.5-40	20-64	var.	var.	2-6	10-32

**Material:** Solid carbide

## End mill cutters

units	d <sub>1</sub>	R	d <sub>2</sub>	l <sub>2 short</sub>	l <sub>2 long</sub>	l <sub>3</sub>	angle	z	DL
mm	10-32	var.	10-32	12.5-40	20-64	var.	var.	2-10	10-32

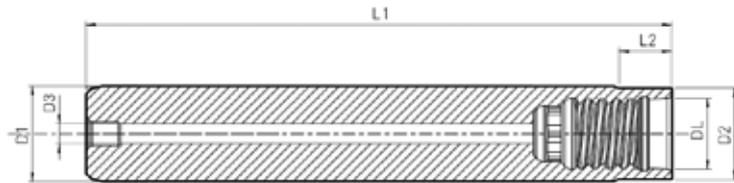
**Material:** Solid carbide

# Duo-Lock™ accessories

## Duo-Lock™ Extensions – Cylindrical

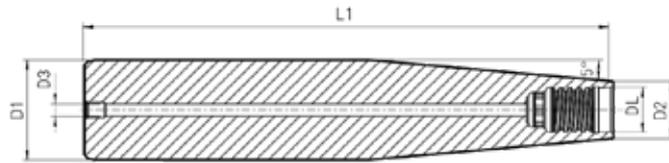
### Version: Cylindrical

- › Shank tolerance: h6
- › With inner coolant bore
- › Optional with Safe-Lock



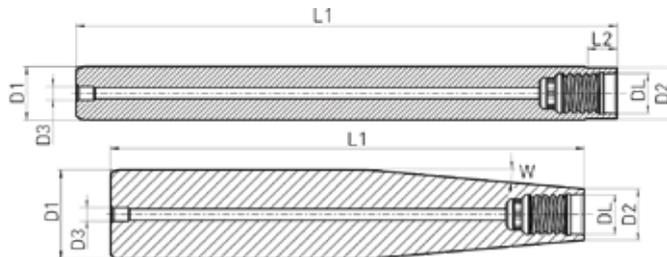
### Version: Conical

- › Shank tolerance: h6
- › With inner coolant bore
- › With Safe-Lock as standard



### Version: Heavy Metal

- › L1, L2 and angle W freely selectable
- › Shank tolerance: h6
- › With inner coolant bore
- › Optional with Safe-Lock



### Version: Carbide Metal

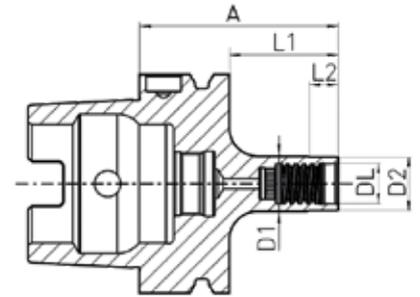
- › L1 and L2 freely selectable
- › Shank tolerance: h6
- › With inner coolant bore
- › Optional with Safe-Lock



## Duo-Lock™ Monoblock Holder

Duo-Lock™ Monoblock holder for direct clamping.  
Perfectly suitable for milling with short overhang.

- All holders incl. inner coolant
- Hardened 54-2 HRC



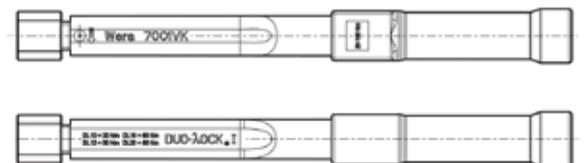
## Duo-Lock™ Hand Wrench

- Useable for Duo-Lock™ tool heads from DL10 – DL20
- For replacing Duo-Lock™ tool heads directly in the lathe



## Wera 7001 Torque Wrench DL10 – DL20

- Wera 7001 torque wrench with changeover ratchet
- For changing Duo-Lock™ tool heads directly in the lathe
- Torque: 20 – 100 Nm
- Useable for Duo-Lock™ milling heads from DL10 – DL20
- Connecting size 9 x 12 mm
- Changeable to clockwise and counter clockwise



## Duo-Lock™ Inserts for Wera 7001 Torque Wrench

- For changing Duo-Lock™ tool heads directly in the lathe
- Changeable inserts for Wera 7001 torque wrench
- Useable for Duo-Lock™ milling heads from DL10 – DL20
- Connecting size 9x12 mm

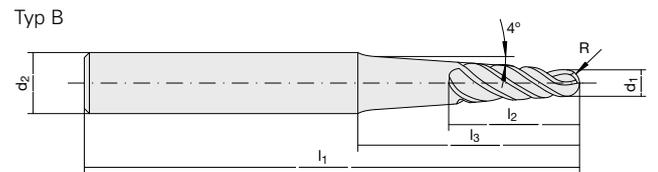
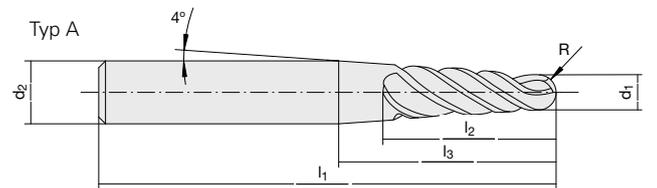


Torque of Duo-Lock™ interface						
	DL10	DL12	DL16	DL20	DL25	DL32
Nm	20	30	60	80	100	130

# Standard Tools

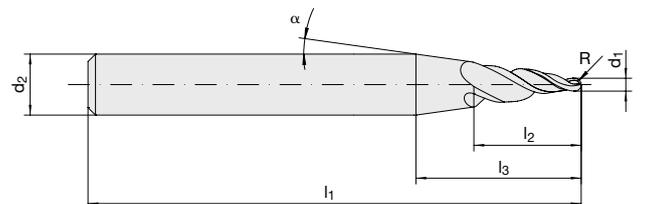
## Taper ball nose cutters

$d_1$	R	$d_2$	$l_1$	$l_2$	$l_3$	z	Typ	Position Nr.
3	1,5	10	110	20	30	3	B	216 700.4
4	2	10	110	25	45	3	A	216 751.4
4	2	10	110	30	45	4	A	216 701.4
5	2,5	12	110	25	52	3	A	216 753.4
5	2,5	12	110	20	40	4	B	216 702.4
6	3	12	110	30	46	3	A	216 755.4
6	3	12	110	30	46	4	A	216 703.4
7	3,5	12	110	40	40	4	A	216 756.4
8	4	12	110	33	33	3	A	216 757.4
8	4	12	110	30	33	4	A	216 704.4
10	5	16	110	35	48	3	A	216 758.4
10	5	16	110	35	48	4	A	216 705.4
10	5	16	110	35	48	4	A/C	216 865.4
12	6	16	110	35	35	4	A	216 706.4
12	6	16	110	35	35	4	A/C	216 866.4
16	8	20	110	37	37	4	A	216 707.4
16	8	20	110	37	37	4	A/C	216 867.4
20	10	25	160	45	45	4	A	216 708.4
20	10	32	250	50	96	4	A	216 709.4
25	12,5	40	330	50	119	4	A	216 740.4



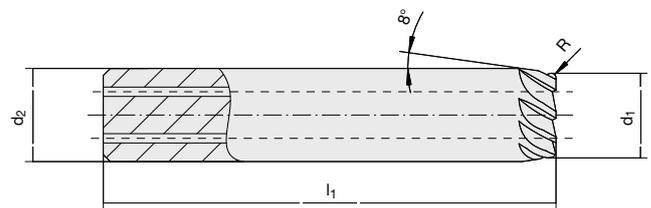
Typ C  
Roughing, semi-finishing tool with chip breakers

$d_1$	R	$d_2$	$l_1$	$l_2$	$l_3$	z	$\alpha$	Position Nr.
3	1,5	10	80	15	35	3	6°	216 962.4
3	1,5	10	110	15	35	3	6°	216 963.4
4	2	10	80	30	30	4	6°	216 964.4
4	2	10	110	30	30	4	6°	216 965.4
5	2,5	12	80	35	35	4	6°	216 966.4
5	2,5	12	110	35	35	4	6°	216 967.4
6	3	12	80	31	31	4	6°	216 968.4
6	3	12	110	31	31	4	6°	216 969.4
3	1,5	10	80	12	26	3	8°	216 322.4
3	1,5	10	110	12	26	3	8°	216 323.4
4	2	10	80	23	23	4	8°	216 324.4
4	2	10	110	23	23	4	8°	216 325.4
5	2,5	12	80	27	27	4	8°	216 326.4
5	2,5	12	110	27	27	4	8°	216 327.4
6	3	12	80	25	25	4	8°	216 328.4
6	3	12	110	25	25	4	8°	216 329.4

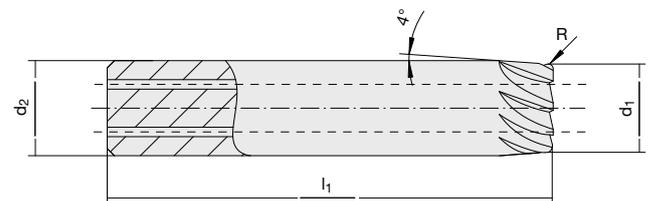


## Torus cutters

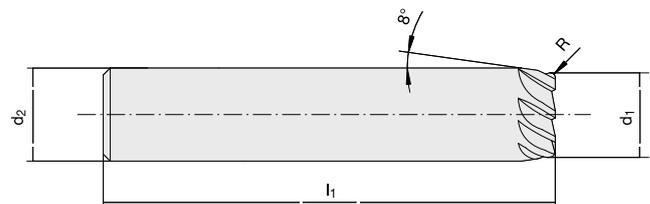
$d_1$	R	$d_2$	$l_1$	z	Position Nr.
8	0,8	10	80	8	216 651.4
10	1	12	80	6	216 652.4
10	1	12	80	8	216 653.4
10	1	12	110	6	216 654.4
10	1	12	110	8	216 655.4
11	1	12	80	10	216 656.4
15	1	16	110	10	216 657.4
19	1	20	110	12	216 658.4
24	1	25	110	14	216 659.4



$d_1$	R	$d_2$	$l_1$	z	Position Nr.
15	1	16	110	8	216 553.4
18	1	20	110	10	216 554.4
19	1	20	110	10	216 555.4
24	1	25	110	12	216 557.4



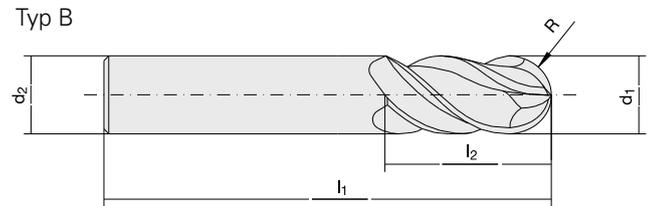
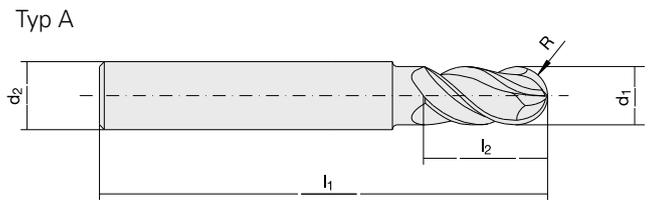
$d_1$	R	$d_2$	$l_1$	z	Position Nr.
8	0,8	10	80	8	216 600.4
10	1	12	80	6	216 601.4
10	1	12	80	8	216 602.4
10	1	12	110	6	216 603.4
10	1	12	110	8	216 604.4
11	1	12	80	8	216 605.4
15	1	16	110	10	216 606.4
16	1,5	20	110	6	216 607.4
19	1	20	110	12	216 608.4



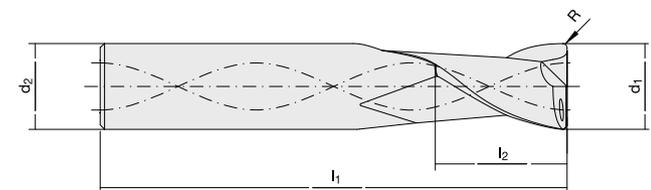
# Standard Tools

Cylindrical ball nose and end mill cutters.

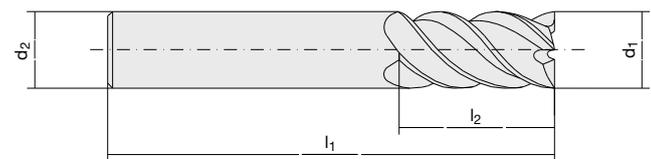
$d_1$	R	$d_2$	$l_1$	$l_2$	z	Typ	Position Nr.
3	1,5	6	80	6	2	A	216 801.4
4	2	6	80	8	2	A	216 802.4
6	3	6	80	10	2	B	216 803.4
8	4	8	80	20	4	B	216 804.4
10	5	10	80	22	4	B	216 805.4
12	6	12	80	22	4	B	216 806.4
16	8	16	110	27	4	B	216 807.4
20	10	20	110	35	4	B	216 808.4
25	12,5	25	110	35	4	B	216 809.4



$d_1$	$d_2$	$l_1$	$l_2$	R	z	Coolant channels	Position Nr.
12	12	80	22	1	2	2	216 954.4
16	16	110	27	1	2	2	216 955.4
20	20	110	30	1	2	2	216 956.4
25	25	110	30	2,5	2	2	216 957.4
32	32	110	30	2,5	3	1	216 958.4



$d_1$	$d_2$	$l_1$	$l_2$	z	Position Nr.
5	6	64	12	3	216 900.4
6	6	64	15	4	216 901.4
8	8	80	20	4	216 902.4
10	10	80	22	4	216 904.4
12	12	80	22	4	216 906.4
16	16	110	27	4	216 907.4
20	20	110	35	4	216 908.4
25	25	110	40	4	216 909.4



# 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
- › Argentina, Buenos Aires
- › Mexico, Querétaro
- › Canada, Guelph
- › Austria, Stainz
- › Turkey, Bursa
- › Romania, Pitesti
- › China, Wuhan
- › China, Suzhou
- › China, Chengdu
- › India, Pune, Banglaore, Chennai, Gurgeon
- › Korea, Pyeongtaek, Busan

**oerlikon**  
balzers

To find your local regrinding support center, please contact us.



# Everything for complete turnkey solutions

Starrag provides cutting tools and much more for a complete turnkey solution with the highest productivity.

## **This includes:**

- › Technology solutions incl. CAM projects, NC data and simulation results
- › Complete tooling solution incl. Starrag and non-Starrag tools
- › Toolholders and toolholder accessories
- › Tool setters and balancing systems
- › Stamping units for clamping e. g. raw barstock for blade machining
- › Part specific fixturing solutions

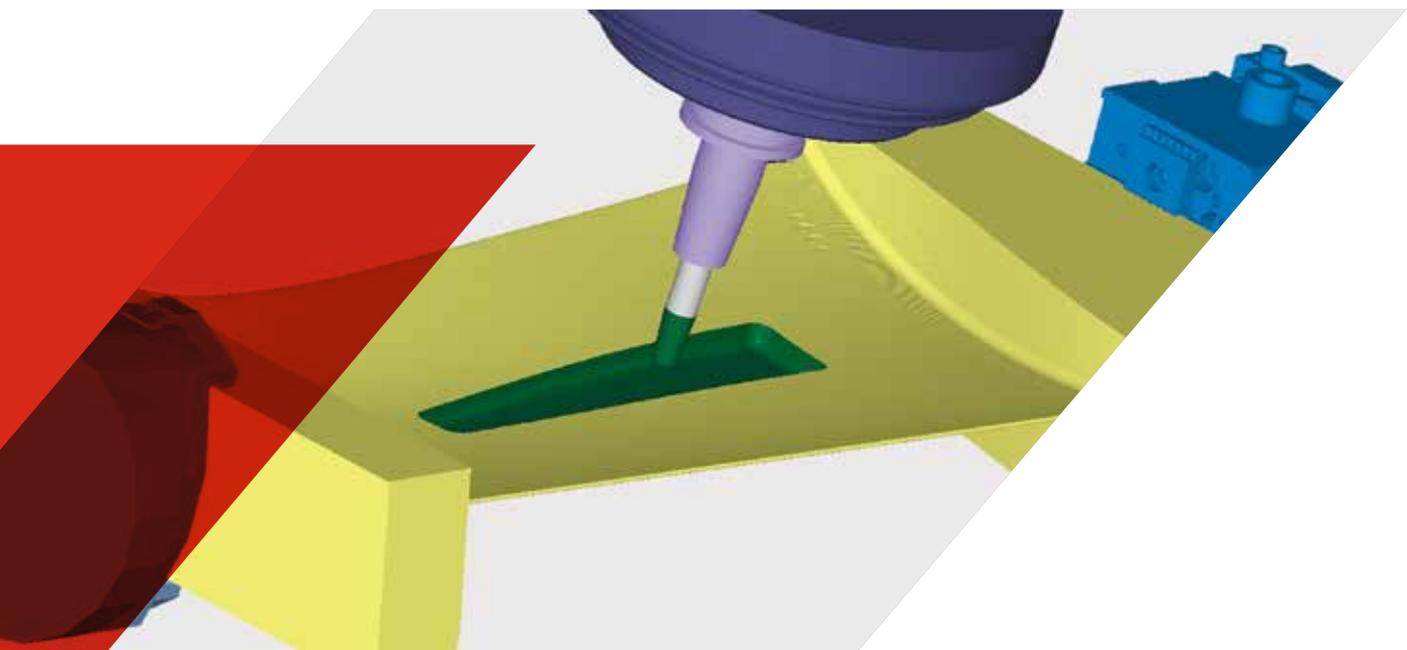
## **RCS – the original CAM software**

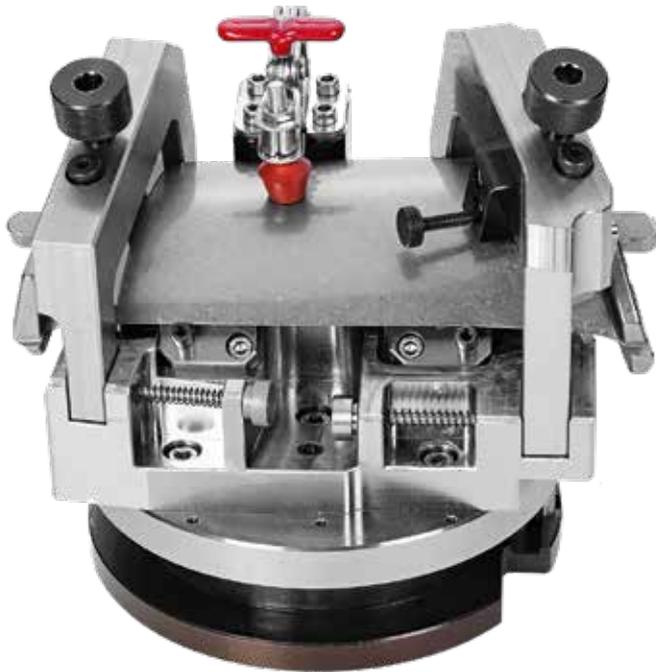
RCS is a dedicated CAM Software, standing behind it over 30 years of experience in the blade CAM industry. Developed and tested at Starrag in Switzerland with the specific intent of producing efficient programming and machining techniques for turbine blades.

## **PSI+ – the programming solution for Blisks and Impellers**

PSI+ is Starrag's dedicated CAD/CAM solution specifically for the efficient programming and subsequent milling of multiblade components such as impellers, blisks/IBRs, diffusers or nozzle guide rings.

PSI+ is designed to be the optimal link between the CAD data of the designer and the perfectly milled workpiece of the production engineer. The purpose of PSI+ is to provide real benefits for real production.





### **Innovative clamping concepts**

Special workpiece geometries create specific demands on the clamping fixtures. Starrag has in-house specialists developing individual clamping concepts to meet the specific requirements of blade machining. Starrag offers the following advantages:

- A single adapter design solution for all LX machine sizes using vices (at the hub) and hydraulic clamping jaws (at the shroud)
- Clamping jaws can be used both for raw and for pre-machined surfaces
- Distortion free machining due to flexible changeover between centrally and floating clamping
- Starrag solutions enable distortion and indentation free clamping on free-form surfaces for the manufacturing of unstable blades
- Geometric deviations between multiple fixtures can be stored in the control system. Measuring of blanks can therefore often be eliminated
- Hydraulic fixtures add clamping into the system



## Online, easy and convenient

Order your specific tool conveniently via the corresponding web link or directly with the QR code.

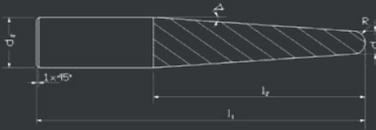
If you would like to consult with one of our tool experts, please call +41 71 858 81 91 and they will happily answer any queries you have.

**[tools@starrag.com](mailto:tools@starrag.com)**



# Tool request

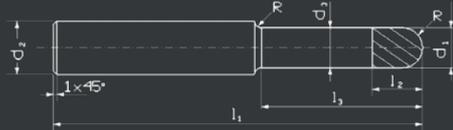
## Taper ball nose cutter



[starrag.com/taperballnose](http://starrag.com/taperballnose)



## Cylindrical ball nose cutters



[starrag.com/cylindricalballnose](http://starrag.com/cylindricalballnose)



## Torus cutter



[starrag.com/torus](http://starrag.com/torus)



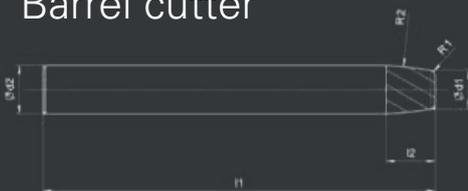
## Convex torus cutter



[starrag.com/convextorus](http://starrag.com/convextorus)



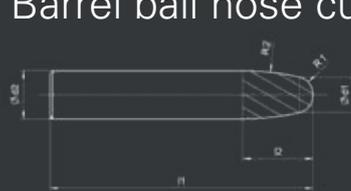
## Barrel cutter



[starrag.com/barrel](http://starrag.com/barrel)



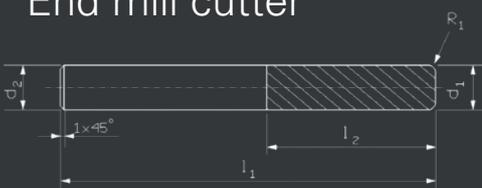
## Barrel ball nose cutter



[starrag.com/barrelballnose](http://starrag.com/barrelballnose)



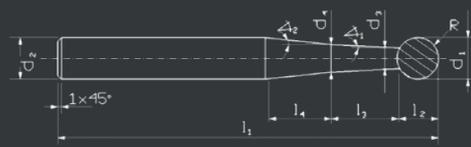
## End mill cutter



[starrag.com/endmill](http://starrag.com/endmill)



## Lollipop cutter



[starrag.com/lollipop](http://starrag.com/lollipop)



