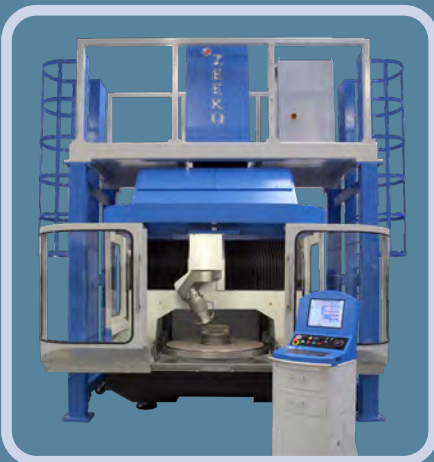
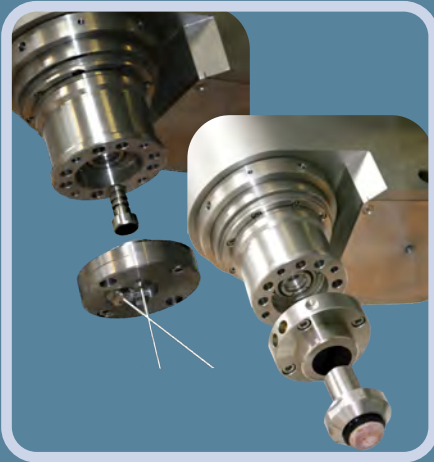


Complete Fabrication Solutions for Complex Ultra-Precision Surfaces



**Shape Adaptive Grinding
(SAG)**

Ultra-Precision Polishing

ZephyrCAM Software

Integrated Metrology

Table of Contents

1. ZephyrCAM Software Range.....	3
2. Zeeko Intelligent Robotic Polishers (IRP) Machine Range IRP50 to IRP1600.....	4
3. What is the Zephyr SAG process?.....	5
4. SAG Tool Structure.....	7
5. SAG Cloths	8
6. Tool Geometries	10
7. How to choose a tool?.....	11
8. Zeeko Tools for IRP Machines	13
8.1 Introduction.....	13
8.2 Bonnet Tools	13
9. Chuck Options.....	14
10. Polishing Tool Kits	15
11. Specialist Toolholders	16
12. Polishing Cloths.....	18
13. Cloth Moulding Tools.....	19
13.1 For moulding Polyurethane and all other suitable polishing cloths.....	19
14. Zeeko Traditional Polishing Tools	20
15. Zeeko Pitch Polishing Tools.....	21
16. SAG Tools for Optics	22
17. Zeeko Zephyr Range.....	24
17.1 Small Tool Polishing Range for Optics (Standard Tools)	24
18. Zeeko Zephyr Small Tool Polishing Range for Optics (Super-Soft Tools).....	25
19. Zeeko Zephyr – “New Age” Smoothing Tools.....	26
20. Accessories.....	27
20.1 Specialist Toolholders	27
21. Safe Process Parameters.....	28
22. SAG Plus and Slurries for Super-polishing ($R_a \leq 2\text{nm}$).....	29

1. ZephyrCAM Software Range



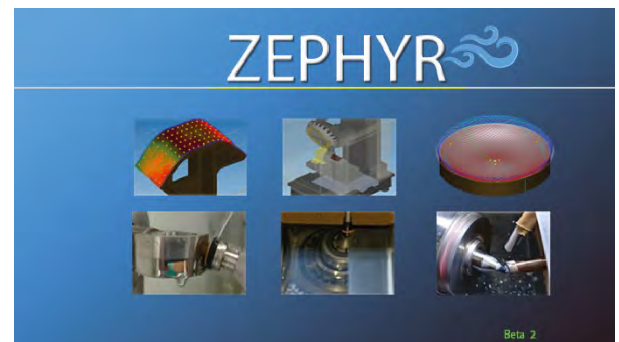
ZephyrCAM Pro



ZephyrCAM Industrial



ZephyrCAM for Robots



ZephyrCAM Lite

ZephyrCAM software is the class leading polishing software from Zeeko. With 25 years of real life, freeform polishing experience now embedded in its applications, the software includes tailored solutions to all the challenging optics it has been called upon to polish during that time.

Replacing the equally successful Precessions and TPG software, ZephyrCAM is now available for application to industrial robots as well as a large variety of third-party CNC machines.

Low cost "shining" versions are available, and this release is suitable for mid spatial removal of (for example) a single point diamond turning signature.

Also available are grinding versions for SAG smoothing of optical glass, ground using traditional hard tooling.

Finally ZephyrCAM Pro is the high end full corrective polishing software.

All ZephyrCAM software is available bundled with Zeeko's MTK (Metrology ToolKit) software.

2. Zeeko Intelligent Robotic Polishers (IRP) Machine Range IRP50 to IRP1600



IRP50



IRP200 MKII



IRP800



IRP1200

3. What is the Zephyr SAG process?

The Shape Adaptive Grinding (SAG) process was developed by Zeeko between 2014 and the present as a novel process for precision grinding of freeform surfaces. The SAG process can achieve optical finish while maintaining high removal rates as compared to traditional CNC polishing.

A SAG tool can be described as a semi-elastic tool which is driven along the surface by a numerically controlled machine tool. The SAG-tool consists of a rigid metal stem, an elastic rubber layer which is coated with an abrasive layer. The single abrasive particles are held by the bond material.

Characteristic for SAG tools is the elastic tool body, which allows compliance with the freeform surface. The elastic body is covered with an abrasive cloth containing the rigid pellets. It is inside these pellets where the actual abrasive grains are bound.

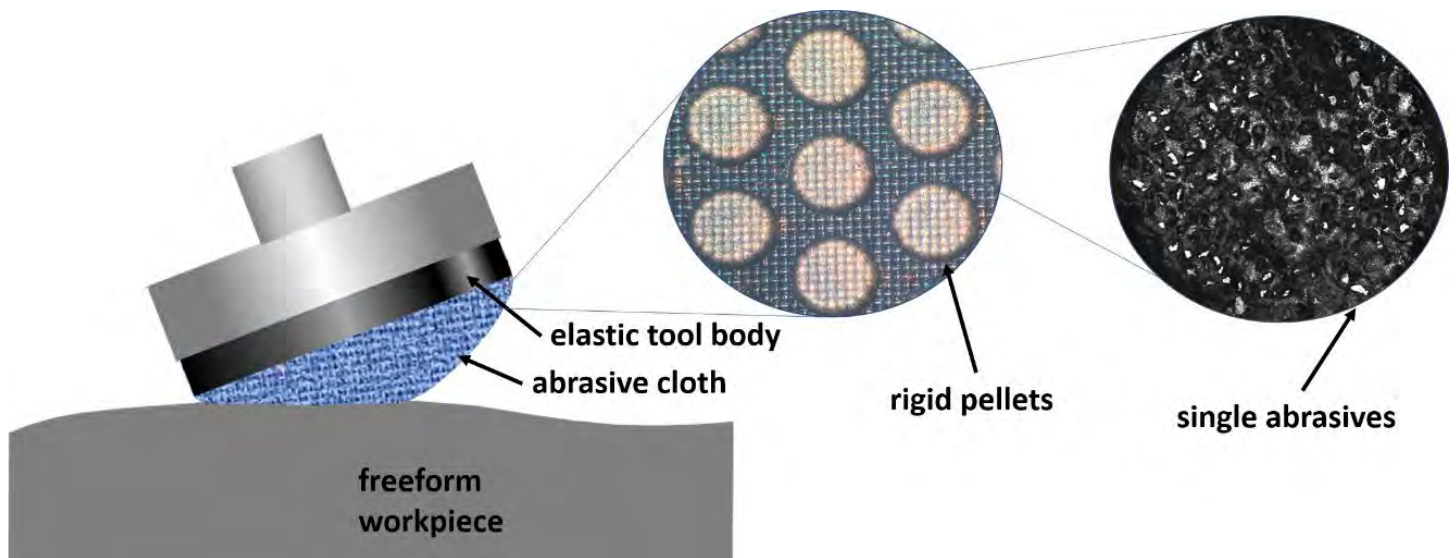


Figure 2-1 Example of the structure of a SAG tool

In Shape Adaptive Grinding the tool is pressed, while rotating, into the workpiece by a certain distance, which is called tool offset. It's this offset which creates the pressure that's needed for the grinding. Increasing the tool offset will also result in a larger contact area between tool and workpiece, which is called grinding spot.

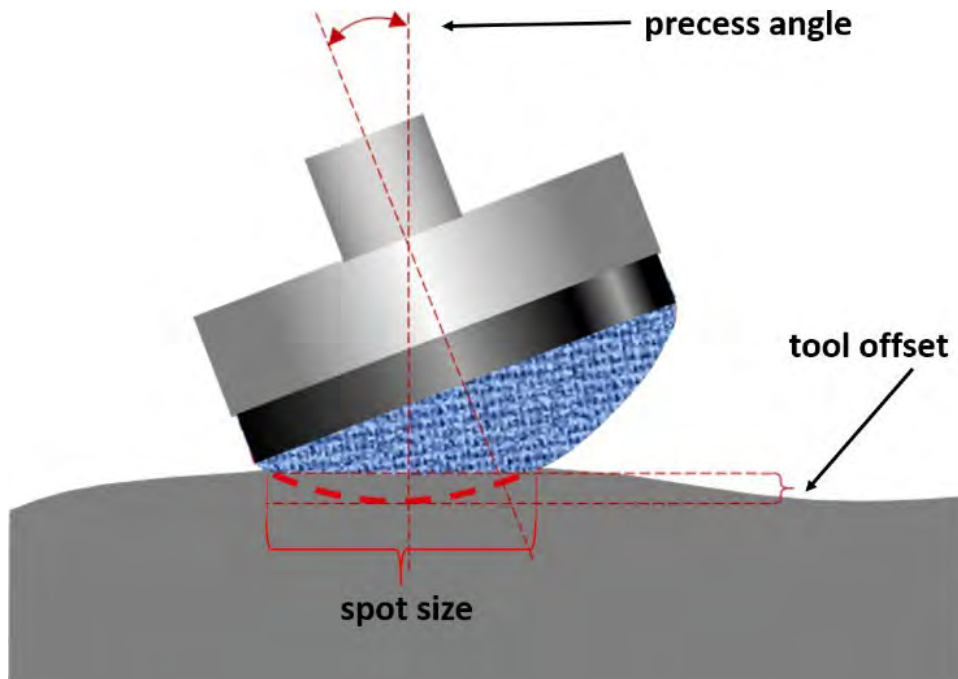


Figure 2-2 How the SAG tools are used

When using bonnet tools or ball-on-stick-tools, a precess angle can be applied. A precess angle is a change in the orientation of the spindle away from the surface normal. A greater precess angle leads to the contact spot being further away from the rotatory axes of the tool.

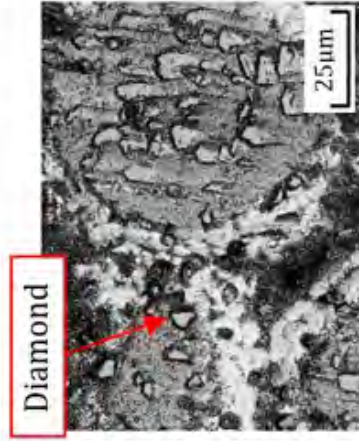
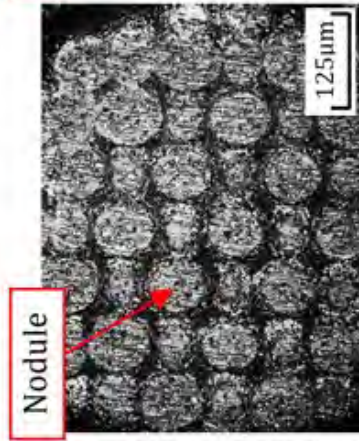
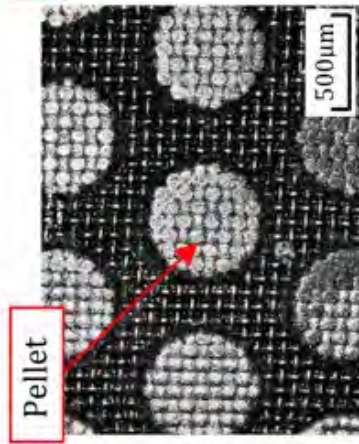
Choosing a larger tool leads to bigger spot sizes for the same offset. A larger spot size means grinding on a bigger area which increases the removal rate and decreases process time.

Shape adaptive grinding is a process that's conceptually situated between polishing and grinding. In the following we would like to highlight of some of these conceptual comparisons to provide a better understanding of the process.

The most prominent difference between SAG and classical grinding is the contact between tool and workpiece. As the contact in classical grinding (with a grinding wheel) can be imagined much like a cut, as seen in milling or drilling processes, this contact takes place for SAG across an arc. The removal process takes place in this area, which we call the contact spot or grinding spot. This important conceptual difference implies that we need to look at certain parameters differently than what we are used to from the classical grinding process.

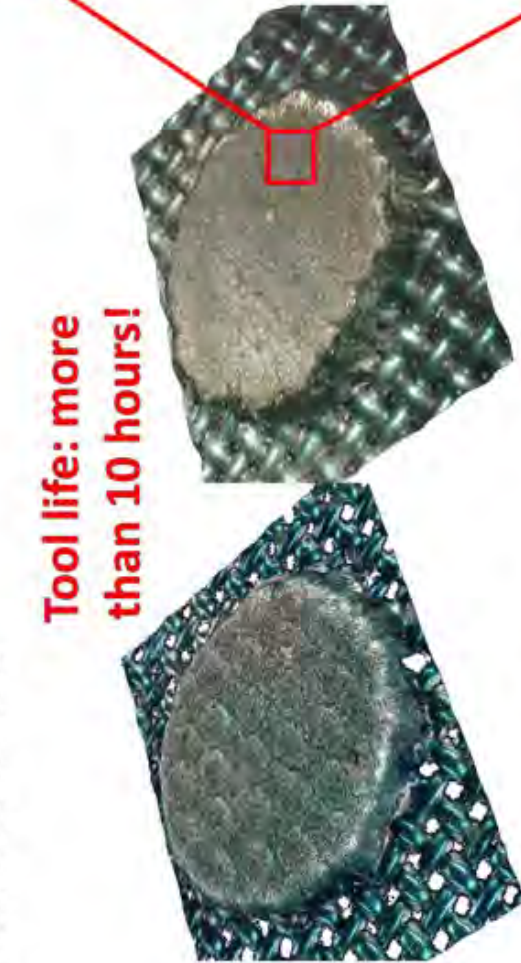
4. SAG Tool Structure

- The structure of SAG tools: **Pellets** (0.5mm) > **Nodules** (80µm) > **Abrasives** (3-40µm).



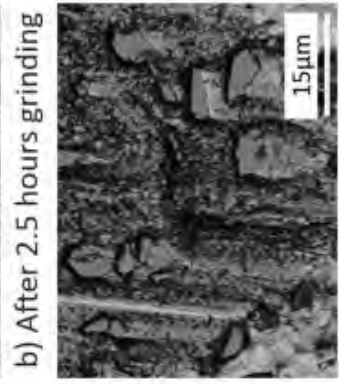
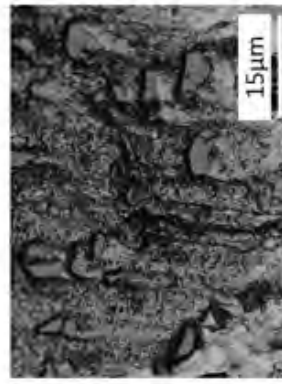
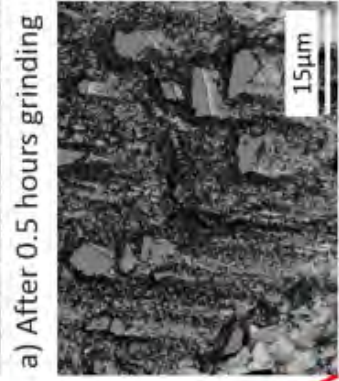
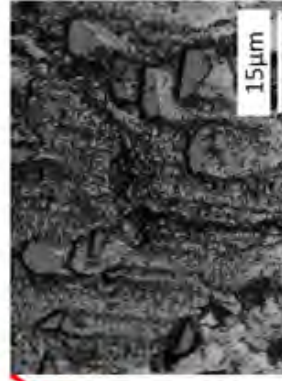
- Even when grinding Silicon Carbide, the **number and shape of abrasives** remains stable for more than **10 hours**.

Tool life: more than 10 hours!



a) Pellet before grinding

b) Pellet after 10 hours grinding



5. SAG Cloths

Zeeko offers tools that come with two types of cloth resin bonded tool and nickel bonded tools.

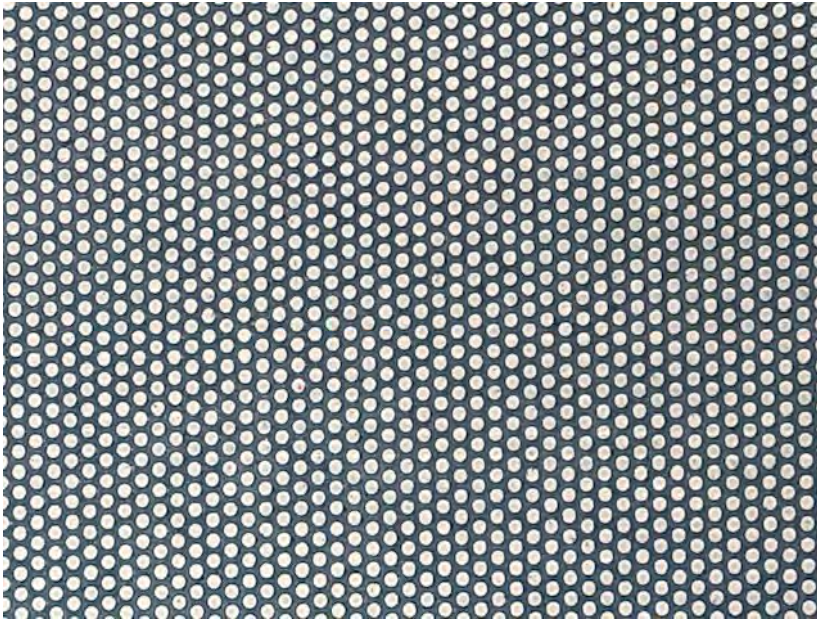


Figure 3-1 Nickel Bonded (NBD)

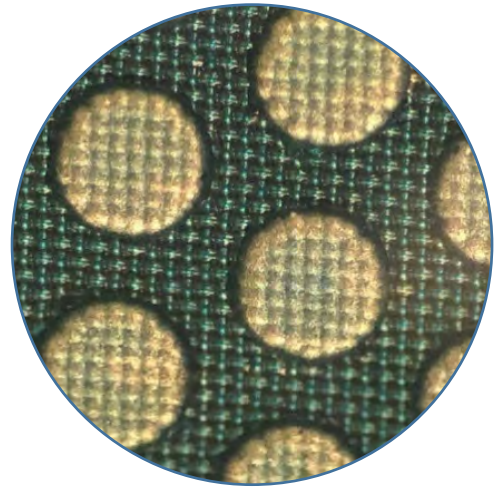
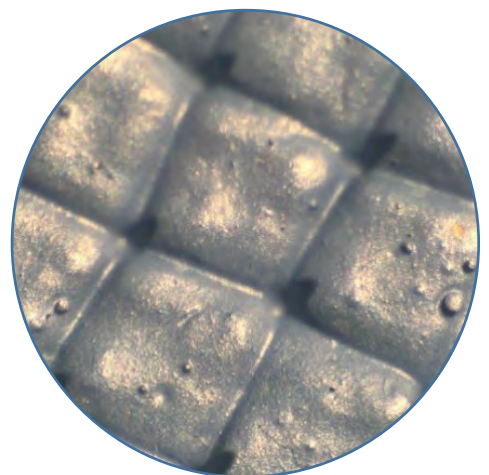
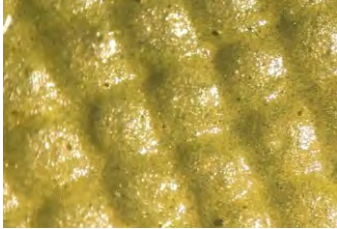

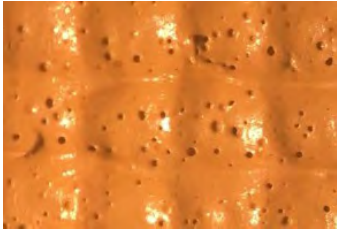
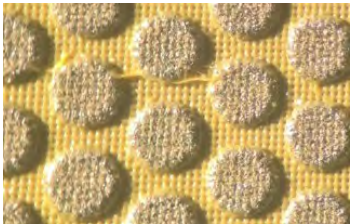



Figure 3-2 Resin Bonded (RBD)



Properties of Bond Materials	
Nickel Bond	Resin Bond
1. Higher wear resistance	1. Higher resistance against impacts
2. Higher thermal conductivity	2. Higher rotational velocity
3. Higher material removal	3. Higher quality surface finish

Resin Bonded Cloth			
Grit Size	Colour	Image	Description
40um	Yellow/Green		This cloth is used for removing machining marks left by former processes. It has a high removal rate at the cost of surface finish and potential crack induction for brittle materials.
9um	Blue		This cloth can achieve high removal rates. It is used for corrective polishing as well as for the removal of cracks induced by higher grit size tools. The resin bonded 9um cloth creates a slightly better surface than its nickel counterpart.
3um	Orange		This cloth is mainly used for finishing runs. It creates the best surface finish among the cloths listed. This comes at the cost of a low removal rate compared to the other cloths in this comparison.

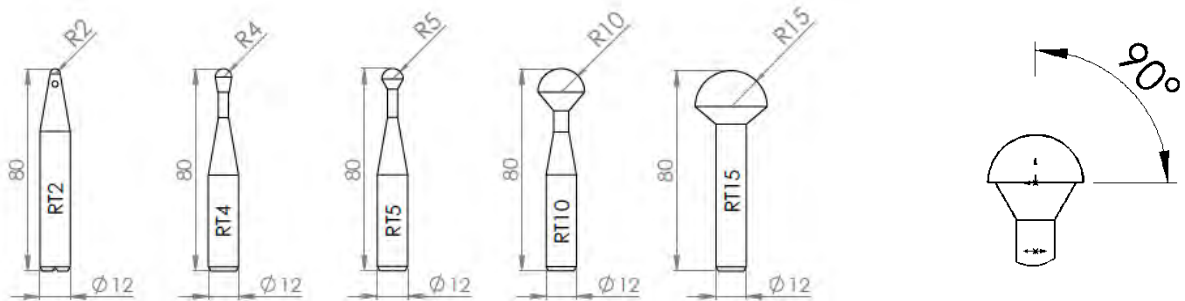
Nickel Bonded Cloth			
Grit Size	Colour	Image	Description
40um	Yellow/Green		This cloth is used to remove machining marks of former processes. It has a high removal rate at the cost of surface finish and brittle removal.
9um	Blue		The 9um nickel bonded cloth has a slightly higher removal rate than its resin counterpart. This cloth is a good choice for form correction and cracks removal.

6. Tool Geometries

There are multiple different tool geometries available in the ZephyrSAG tooling range.

Each has a different working area as shown below. Any tool geometry can be paired with any SAG cloth.

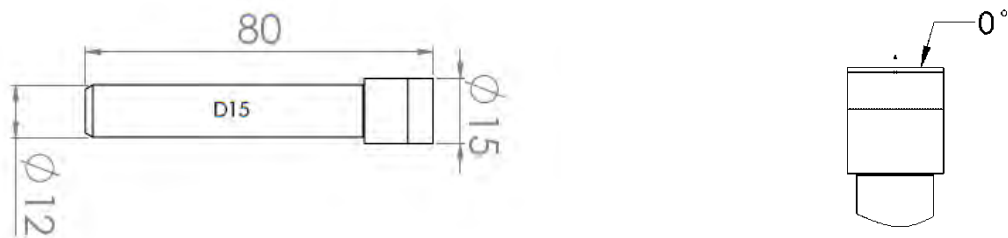
Teardrop (RT)



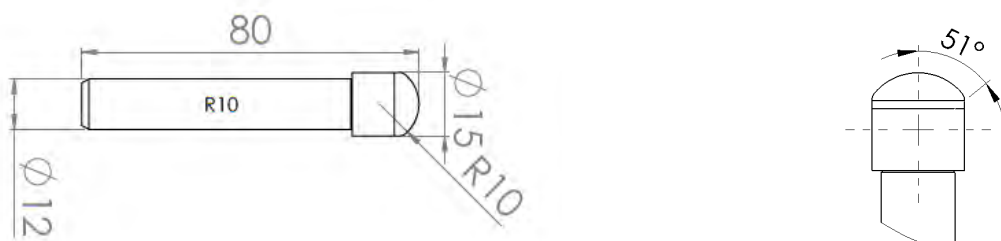
Cap (C)



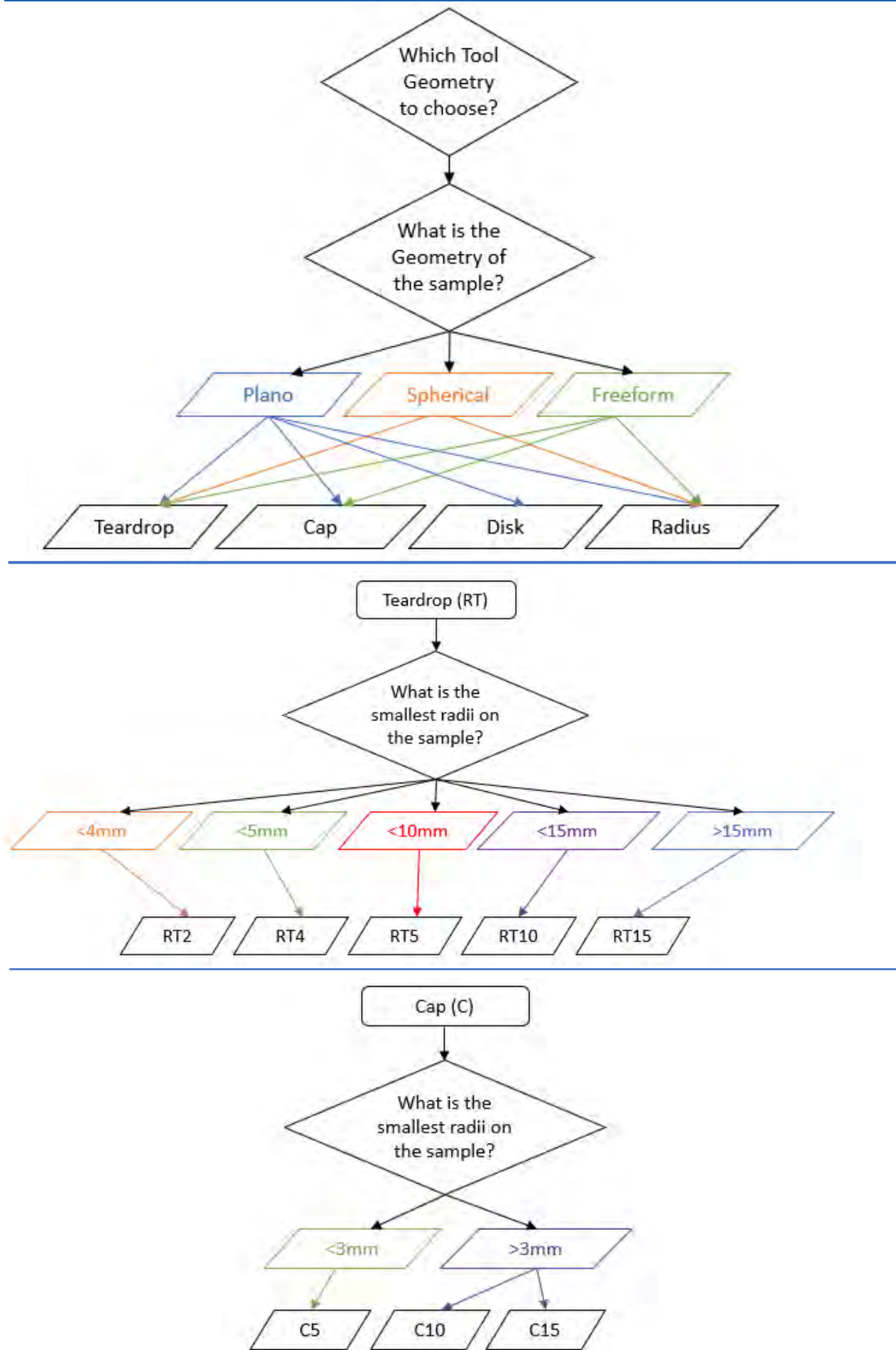
Disk (D)



Radius (R)



7. How to choose a tool?



ORDERING CODE	SS	RT	15	D40	NBD	S12	
HARDNESS RANGE							
Super soft	SS						
Standard	[]						
TOOL SERIES							
Teardrop		RT					
Bonnet		R					
Disc		D					
Cap		C					
Concave		CCV					
TOOL SIZE /mm							
			2				
			4				
			5				
			10				
			15				
			20				
			40				
			<i>On most tooling this refers to the tool radius. On cap tools it refers to diameter.</i>				
GRIT SIZE							
40				D40			
9				D9			
3				D3			
N/A				[]			
			<i>Grit size only applicable on RBD and NBD tooling.</i>				
MATERIAL							
Resin Bond					RBD		
Nickel Bond					NBD		
LP66.					LP6		
HDP					HDP		
Uninap					NAP		
Zeeko Blue					ZKB		
No Cloth					[]		
TOOLSHAFT							
12mm						S12	
None (bonnet only)			<i>All tooling with tool radius ≤15mm must come on a 12mm tool shaft.</i>				[]

8. Zeeko Tools for IRP Machines

8.1 Introduction

This guide has been produced to assist operators of Zeeko machines in the selection of the optimum tool for the polishing task at hand. It details the use of each tool, the part number that should be ordered and the introductory parameters that might be tried with each tool for initial assessment of the tool's performance in the application selected.

8.2 Bonnet Tools

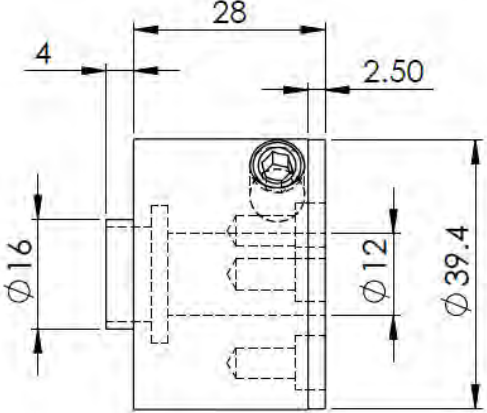
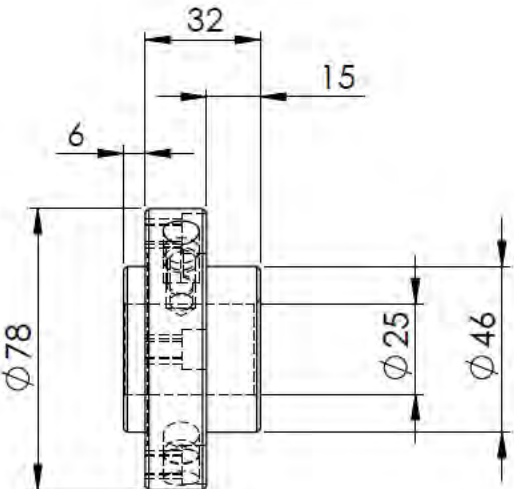
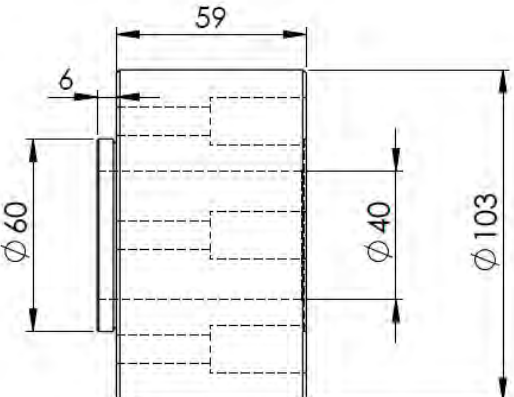
Bonnet tools are the standard tools supplied with all IRP machines. The most common are inflated membrane tools with a polishing cloth fixed to the surface with adhesive that is usually applied by the customer himself. There is a separate document to describe the fabrication of these tools + polishing cloth.

The traditional inflated membrane tools are designed to be mounted in the Zeeko Toolholder (as shown below). The bonnet is retained by a screwed clamp ring with "O" ring seal and "slip ring" or "washer" as shown in the below exploded view:



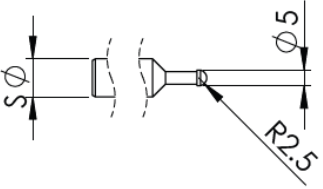
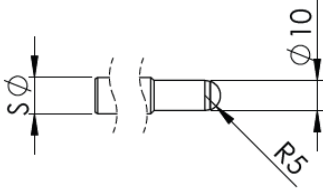
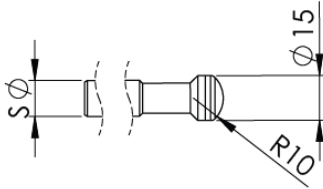
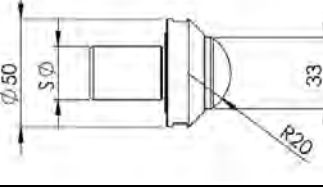
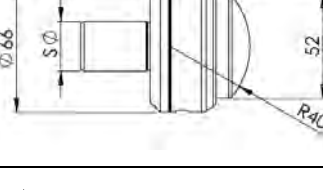
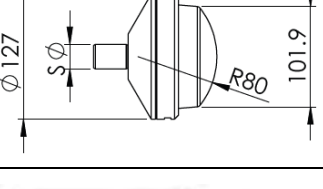
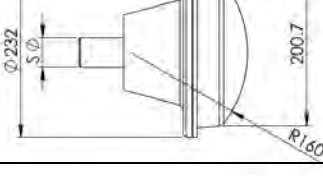
9. Chuck Options

Zeeko offers 3 different standard tool chuck options:

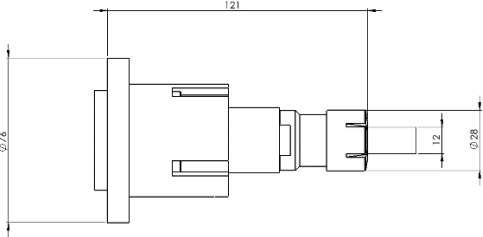
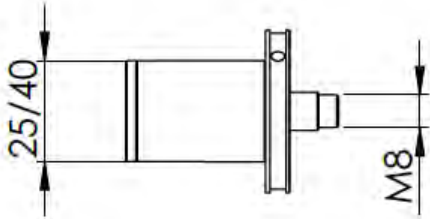
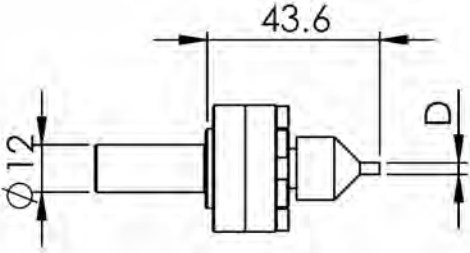
Chuck Details	Part Number	Comment
<p>12mm Schunk Hydrodehn Chuck</p> 	<p>200080</p> <p>The 12mm shank Schunk chuck as fitted to the IRP 100 and IRP 50 machines but also used on ALL IRP and RPC machines for carrying the popular 12mm tool range</p>	<p>A 12mm chuck is fitted as standard to the IRP 50 and IRP 100 ranges but that is a different part number. This 12mm Schunk chuck is for the small tool range only and is mounted to the H-axis polishing heads using the adaptors shown on pages 14 & 15</p>
<p>25mm Schunk Hydrodehn chuck</p> 	<p>200008</p> <p>The 25mm shank Schunk chuck. This is the most common option found on the IRP 200 and IRP 400 machines and their variants</p>	<p>Fitted as standard on IRP 200Mk1, IRP 200 Mk2, IRP 400 and IRP 400LM machines and their variants as well as all RPC units using the IRP 200 polishing head</p>
<p>40mm Schunk Hydrodehn Chuck</p> 	<p>200009</p> <p>The 40mm shank Schunk chuck which is fitted to the IRP 600, IRP 800, IRP 1000 and IRP 1200 machines and their variants</p>	<p>Fitted as standard on IRP 600, IRP 600 LM, IRP 800, IRP 800LM, IRP 1000 and IRP 1200 machines and their variants as well as all RPC units using the IRP 600, IRP 800 or IRP 1200 polishing heads</p>

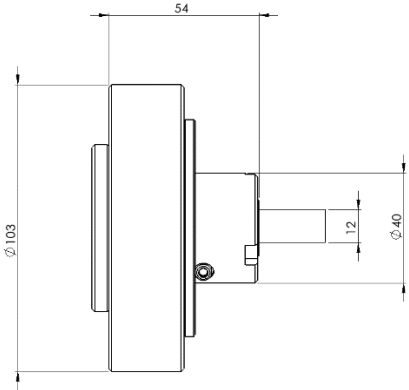
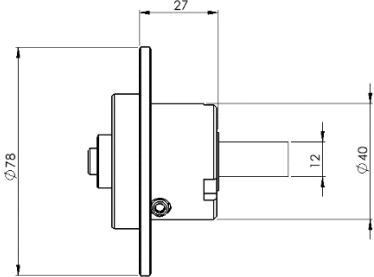
10. Polishing Tool Kits

Zeeko tool kits include the components required to assemble rubber bonnet polishing tools of a chosen radius and shank diameter, as well as the appropriate cloth forming tool and spray deflector (for tools $\geq R20$). For tools of radius $\geq R20$, replacement bonnets can be purchased, both solid and inflatable. See the 'Zeeko Traditional Polishing Tools' section for part numbers.

Bonnet Radius (mm)		Shank Diameter $S\varnothing$ (mm)	Kit Number
R2		12	900170-050
		25	900170-200
R5		12	900167-050
		25	900166-200
		40	90166-600
R10		12	900168-050
		25	900165-200
		40	900165-600
R20		12	900169-050
		25	900150
		40	900142
R40		12	900173-050
		25	900151
		40	900141
R80		25	900152
		40	900159
R160		40	900164

11. Specialist Toolholders

Assembly	Part Number	Description
<p>Constant Force Toolholder (CFT) - 12mm shank</p> 	<p>YB100-000009</p>	<p>This CFT toolholder is normally only used with pitch tools, but can (with special tools and under special direction) be recommended for use with small SAG tools.</p> <p>It mounts directly to the front face of the 200/400 H-axis (with Schunk chuck removed). It requires to be clocked in place. It is used with 12mm tool shafts (held in a collet)</p>
<p>Constant Force Tool Holder (CFT) – 25mm or 40mm shank</p> 	<p>YB100-000011 (25mm) BT900-000001 (40mm)</p>	<p>This Constant Force Toolholder is simple to use as it mounts directly into the appropriate 25mm or 40mm Schunk chuck and uses air pressure to maintain contact and an even force over varying surface geometries. It is available in the 2 variants but please be careful to order the toolholder that is right for your chuck.</p> <p>Any queries or concerns please contact Zeeko first.</p>
<p>Spring Loaded CFT for use with Pitch tools</p> 	<p>LB100-000007</p>	<p>Designed for use without an air supply, this Spring loaded CFT allows for pitch polishing on any machine tool capable of holding the 12mm shank. Various tip sizes (D) available from 3mm to 10mm.</p>

Assembly	Part Number	Description
<p>40mm Schunk Chuck “Small Tool Toolset” Adaptor (this is NOT a Constant Force Toolholder)</p> 	<p>FC120-000307</p>	<p>This assembly is also NOT a Constant Force Toolholder. It is for converting 600/800/1200 H-axis 40mm Schunk chucks to hold 25mm shank tools and toolholders. Used together with GC120-000243 (above), this toolset can also allow 12mm shank tools to be used. All tools smaller than R80 bonnet Radius are available with 12mm diameter shaft size.</p> <p>This part required to be clocked into position.</p>
<p>25mm Schunk Chuck “Small Tool Toolset” Adaptor (this is NOT a Constant Force Toolholder)</p> 	<p>GC120-000243</p>	<p>This assembly is NOT a Constant Force Toolholder it is for holding tools rigidly and is for converting 200/400 H-axis machines with a 25mm Schunk chuck to use the Zeeko 12mm shaft small tooling system. All tools smaller than R80 bonnet Radius are available with 12mm diameter shaft sizes.</p>

PLEASE NOTE:

As well as the above toolsets and toolholders Zeeko also has a number of specialists toolholders including oscillating tool post and indexing tool post designs. For more information please enquire direct to Zeeko with as much information about your requirements as possible

12. Polishing Cloths

For standard optics polishing there are a choice of cloths available:

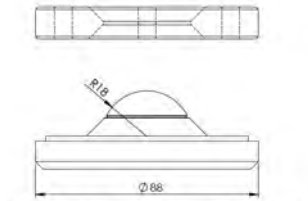
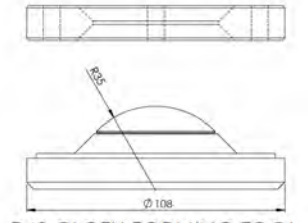
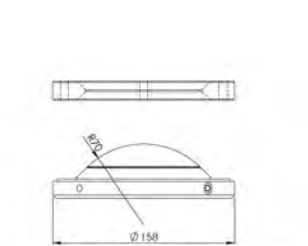
Cloth Name	For ordering please quote	Recommended Use
Regular Polyurethane	POLYURETHANE-210 X 297mm	Use for pre-polishing and regular corrective polishing on most optical materials
LP66 (polyurethane)	LP66-210 X 297mm	Use for pre-polishing and regular corrective polishing on most optical materials
High Density Polyurethane	HDPU-210 X 297mm	Use for pre-polishing and regular corrective polishing on most optical materials
Zeeko Blue Cloth	ZKOBLUE- 210 X 297mm	For finishing, fine finishing and super polishing most optical materials
NBD and RBD SAG Material	See tool section	Due to the extreme difficulty of forming this material it is NOT supplied separately

(There are other polishing cloths that may be recommended in special circumstances and will be supplied under special order)

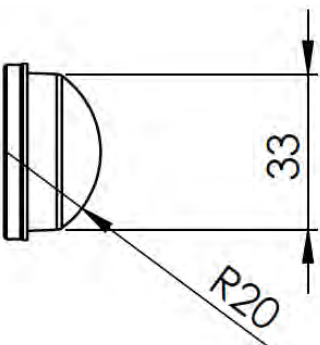
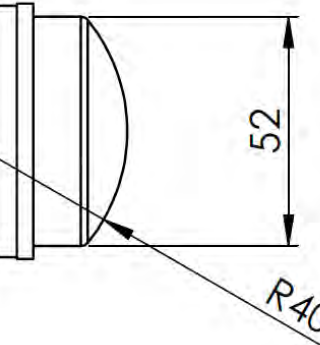
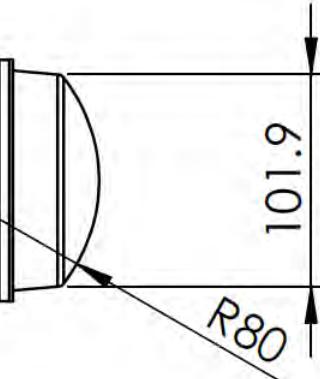
13. Cloth Moulding Tools

13.1 For moulding Polyurethane and all other suitable polishing cloths

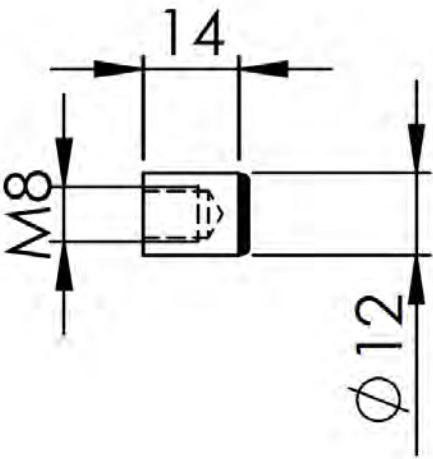
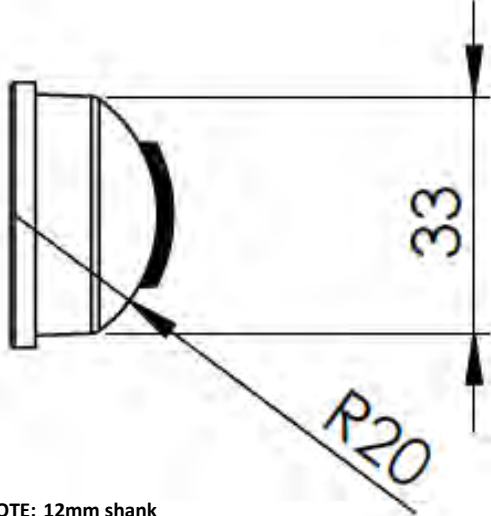
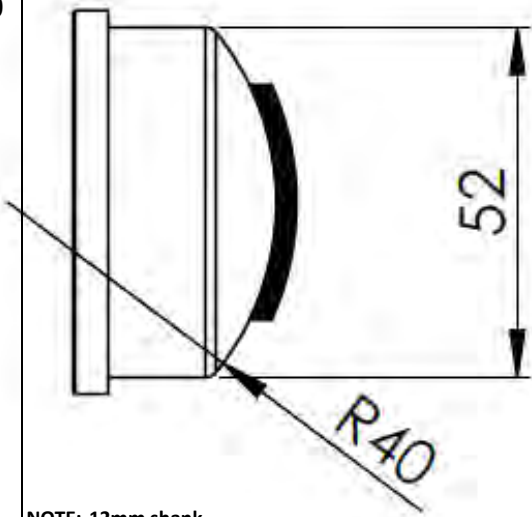
For each bonnet size there is a

Assembly	Part Number	Description/ Comments
 <p>R20 CLOTH FORMING TOOL</p>	600161	<p>This mould can be used for moulding (in the presence of heat) most polishing pad material including LP66, Polyurethane, High Density Polyurethane, UNINAP and Zeeko Blue cloths for use on R20 bonnets (both inflatable and solid and also New Age Smoothing tools). For guidelines on forming and bonding please see the separate publication “Bonnet Care”</p>
 <p>R40 CLOTH FORMING TOOL</p>	600160	<p>This mould can be used for moulding (in the presence of heat) most polishing pad material including LP66, Polyurethane, High Density Polyurethane, UNINAP and Zeeko Blue cloths for use on R40 bonnets (both inflatable and solid and also New Age Smoothing tools). For guidelines on forming and bonding please see the separate publication “Bonnet Care”</p>
 <p>R80 CLOTH FORMING TOOL</p>	600162	<p>This mould can be used for moulding (in the presence of heat) most polishing pad material including LP66, Polyurethane, High Density Polyurethane, UNINAP and Zeeko Blue cloths for use on R80 bonnets (both inflatable and solid and also New Age Smoothing tools). For guidelines on forming and bonding please see the separate publication “Bonnet Care”</p>

14. Zeeko Traditional Polishing Tools

Bonnet Radius		Part Number	Description
R20		226034 226034 – 40A 226034 – 50A 226034 – SS40 224374 224398	R20 Bonnet Inflatable R20 Solid Nitrile Bonnet 40 Shore Hardness R20 Solid Nitrile Bonnet 40 Shore Hardness R20 Bonnet Solid Silicon (40 Shore Hardness) R20 Solid Bonnet 50 Hard Nitrile R20 Solid Bonnet 40 Hard Nitrile
R40		226001 226001-6A 226001-NR40 226001 -SS40 224666 224666-30A 224666-40A 224666-60A 224666-70A 224666-80A 224666-90A	R40 Bonnet Inflatable R40 Bonnet R40 Bonnet (Natural rubber 40 Shore Hardness) R40 Solid Silicon (40 Shore Hardness) R40 Solid Bonnet – 50A Nitrile R40 Solid Bonnet – 30A Nitrile R40 Solid Bonnet – 40A Nitrile R40 Solid Bonnet – 60A Nitrile R40 Solid Bonnet – 70A Nitrile R40 Solid Bonnet – 80A Nitrile R40 Solid Bonnet – 90A Nitrile
R80		226447 226447-NR30 226447-NR40 226447-NR50 226447-NR60 226447-NR70 226447-NR90 226447-SS40	R80 Inflatable R80 Bonnet Solid Nitrile 30A Shore R80 Bonnet (Natural Rubber 40 Shore Hardness) R80 Bonnet Solid Nitrile 50A Shore R80 Bonnet Solid Nitrile 60A Shore R80 Bonnet Solid Nitrile 70A Shore R80 Bonnet Solid Nitrile 90A Shore R80 Bonnet Solid Silicon 40 Shore Hardness
Larger tools than R80 are available (for example R160 and R240) but these are supplied by special order only.			

15. Zeeko Pitch Polishing Tools

Pitch Tools (for optic smoothing)			
D12		<p>M8PITCHS12</p> <p>HARDNESS When ordering, please specify Pitch Hardness:</p> <ul style="list-style-type: none"> - Soft - Medium - Hard 	<p>These tools MUST ONLY be used with the “Constant Force Tip Tool”</p>
R20	 <p>NOTE: 12mm shank Available as 12mm, 25mm and 40mm shank</p>	<p>R20HDPU -PITCH</p> <p>When ordering, please specify Pitch Hardness:</p> <ul style="list-style-type: none"> - Soft - Medium - Hard 	<p>Care must be taken with these tools. They should ONLY BE USED un-inflated unless used in conjunction with a “Constant Force Toolholder” and with a max tool offset of 1mm.</p> <p>The head speed should not exceed 100 rpm</p>
R40	 <p>NOTE: 12mm shank Available as 12mm, 25mm and 40mm shank</p>	<p>R40HDPU -PITCH</p> <p>When ordering, please specify Pitch Hardness:</p> <ul style="list-style-type: none"> - Soft - Medium - Hard 	<p>Care must be taken with these tools. They should ONLY BE USED un-inflated unless used in conjunction with a “Constant Force Toolholder” and with a max tool offset of 1mm.</p> <p>The head speed should not exceed 100 rpm</p>

16. SAG Tools for Optics

There are a small number of SAG tools that are recommended for optics. Usually these SAG tools are used for smoothing and for the initial pre-polishing of ground surfaces prior to optical polishing. They may even be used as the final operation on the grinder prior to transferring the part to the polisher. Use only coolant and not slurry and see the “Guide to SAG/ Tooling Brochure” for additional instructions on their use.

Bonnet Tool – size and description	Part Number	Description
	RT5D9NBDS1	RT5 Solid bonnet with 9um NBD cloth
	RT5D9RBDS12	RT5 Solid bonnet with 9um RBD cloth
	RT5D3RBDS12	RT5 Solid bonnet with 3um RBD cloth
	RT10D9NBDS12	RT10 Solid bonnet with 9um NBD cloth
	RT10D9RBDS12	RT10 Solid bonnet with 9um RBD cloth
	RT10D3RBDS12	RT10 Solid bonnet with 3um RBD cloth
	RT15D9NBDS12	RT15 Solid bonnet with 9um NBD cloth
	RT15D9RBDS12	RT15 Solid bonnet with 9um RBD cloth
	RT15D3RBDS12	RT15 Solid bonnet with 3um RBD cloth
	R10D9NBDS12	R10 Solid bonnet with 9um NBD cloth
	R10D9RBDS12	R10 Solid bonnet with 9um RBD cloth
	R10D3RBDS12	R10 Solid bonnet with 3um RBD cloth
	R20D9NBD	R20 Solid bonnet with 9um NBD cloth
	R20D9RBD	R20 Solid bonnet with 9um RBD cloth
	R20D3RBD	R20 Solid bonnet with 3um RBD cloth
		Please specify Toolholder (sold separately if required) Specify toolholder shank diameter 12mm, 25mm or 40mm

	R40D9NBDS12	R40 Solid bonnet with 9um NBD cloth
	R40D9RBDS12	R40 Solid bonnet with 9um RBD cloth
	R40D3RBDS12	R40 Solid bonnet with 3um RBD cloth
		Please specify Toolholder (sold separately if required) Specify toolholder shank diameter 12mm, 25mm or 40mm

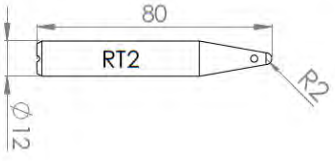
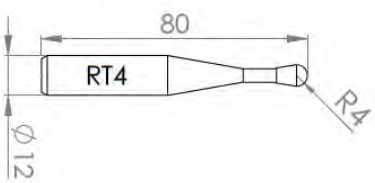
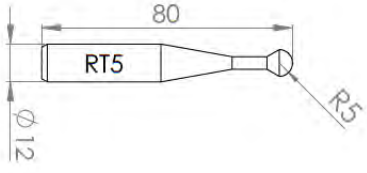
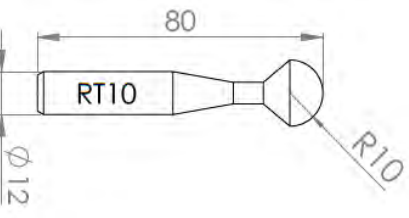
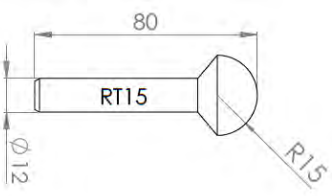
Drum/Edge – Standard Zephyr Polishing Range

	<u>Polyurethane</u>	<u>UNINAP</u>
	E10LP66S12	E10UNINAPS12
	E10HDPS12	
	<u>Polyurethane</u>	<u>UNINAP</u>
	E15LP66S12	E15UNINAPS12
	E15HDPS12	

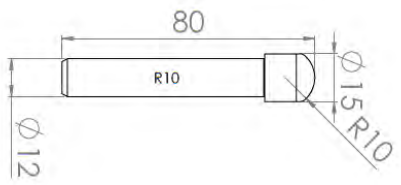
17. Zeeko Zephyr Range

17.1 Small Tool Polishing Range for Optics (Standard Tools)

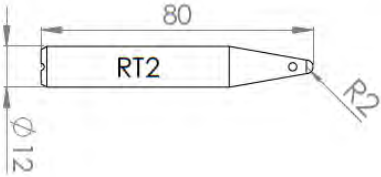
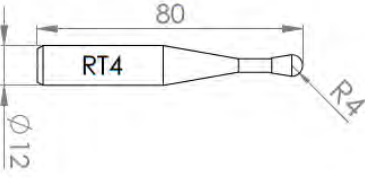
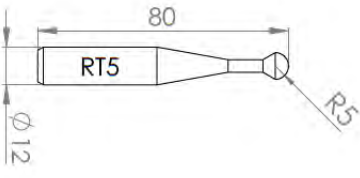
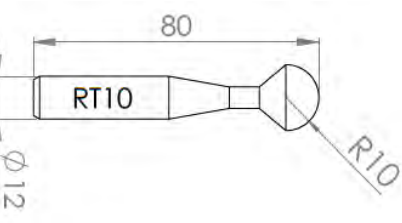
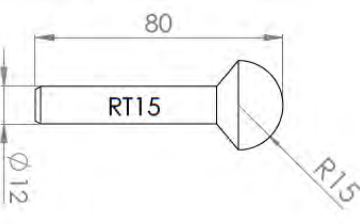
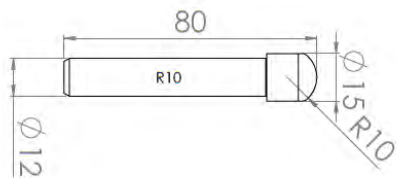
Teardrop (RT) – Standard Zephyr Polishing Range

	<u>Polyurethane</u>	<u>UNINAP</u>	<u>Zeeko Blue</u>
	RT2LP66S12	RT2UNINAPS12	RT2ZKOBLUES12
	RT2HDPS12		
	RT4LP66S12	RT4UNINAPS12	RT4ZKOBLUES12
	RT4HDPS12		
	RT5LP66S12	RT5UNINAPS12	RT5ZKOBLUES12
	RT5HDPS12		
	RT10LP66S12	RT10UNINAPS12	RT10ZKOBLUES12
	RT10HDPS12		
	RT15LP66S12	RT15UNINAPS12	RT15ZKOBLUES12
	RT15HDPS12		

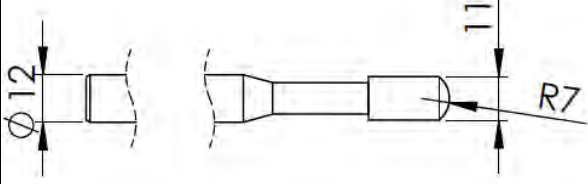
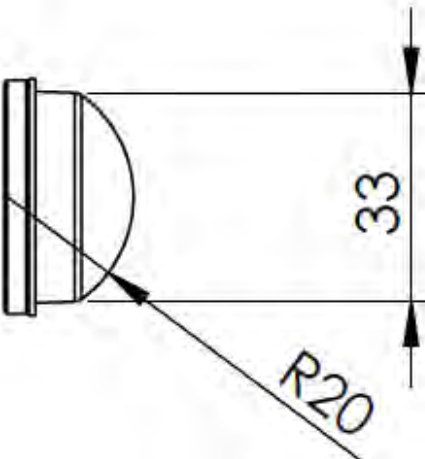
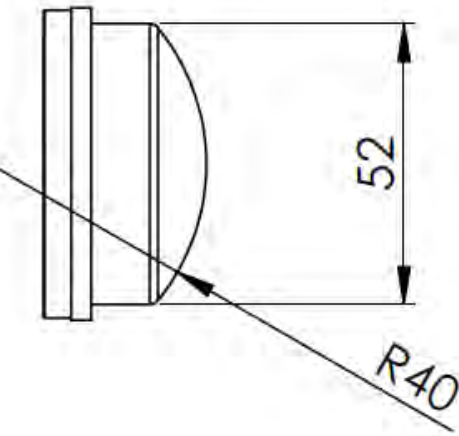
Radius (R) – Standard Zephyr Polishing Range

	<u>Polyurethane</u>	<u>UNINAP</u>	<u>Zeeko Blue</u>
	R10LP66S12	R10UNINAPS12	R10ZKOBLUES12
	R10HDPS12		

18. Zeeko Zephyr Small Tool Polishing Range for Optics (Super-Soft Tools)

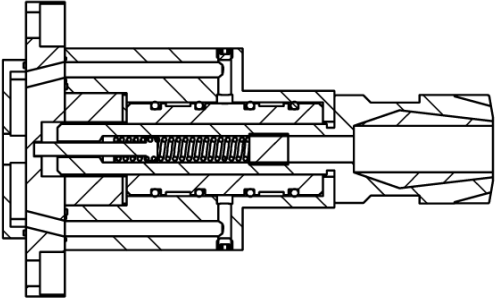
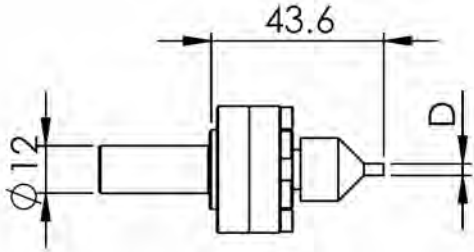
	<u>Polyurethane</u>	<u>UNINAP</u>	<u>Zeeko Blue</u>
	SSRT2LP66S12	SSRT2UNINAPS12	SSRT2ZKOBLUES12
	SSRT2HDPS12		
	SSRT4LP66S12	SSRT4UNINAPS12	SSRT4ZKOBLUES12
	SSRT4HDPS12		
	SSRT5LP66S12	SSRT5UNINAPS12	SSRT5ZKOBLUES12
	SSRT5HDPS12		
	SSRT10LP66S12	SSRT10UNINAPS12	SSRT10ZKOBLUES12
	SSRT10HDPS12		
	SSRT15LP66S12	SSRT15UNINAPS12	SSRT15ZKOBLUES12
	SSRT15HDPS12		
<u>Radius (R) – Supersoft Zephyr Polishing Range</u>			
	<u>Polyurethane</u>	<u>UNINAP</u>	<u>Zeeko Blue</u>
	SSR10LP66S12	SSR10UNINAPS12	SSR10ZKOBLUES12
	SSR10HDPS12		

19. Zeeko Zephyr – “New Age” Smoothing Tools

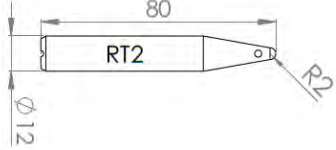
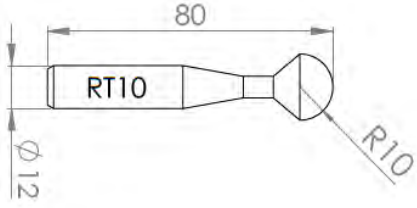
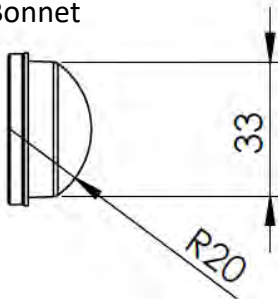
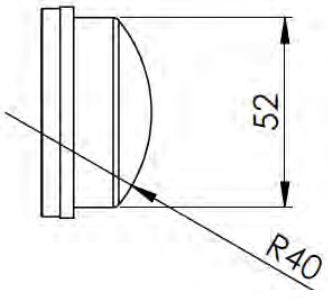
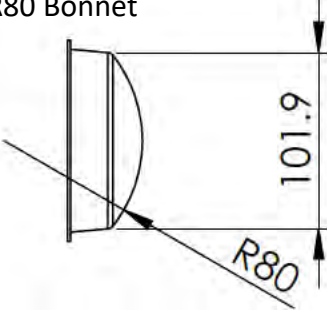
“New Age” Smoothing Tools			
R7		<p>R7NAD2RBDS12</p> <p>R7NAHDPU12</p> <p>R7NAZKOBUES12</p>	<p>R7 New Age Smoothing Tool with 2um RBD pad</p> <p>R7 New Age Smoothing Tool with HD polyurethane pad</p> <p>Smoothing Tool with Zeeko Blue pad</p> <p>(NOTE: this tool has a 12mm shaft size only)</p>
R20	 <p>NOTE: 12mm shank Available as 12mm, 25mm and 40mm shank</p>	<p>R20D2RBD</p> <p>R20NAHDPU</p> <p>R20NAZKOBUE</p>	<p>R20 New Age Smoothing Tool with 2um RBD</p> <p>R20 New Age Smoothing Tool with HD Polyurethane pad</p> <p>R20 New Age Smoothing Tool with Zeeko Blue Pad</p>
R40	 <p>NOTE: 12mm shank Available as 12mm, 25mm and 40mm shank</p>	<p>R40D2RBD</p> <p>R40NAHDPU</p> <p>R40NAZKOBUE</p>	<p>R40 New Age Smoothing Tool with 2um RBD</p> <p>R40 New Age Smoothing Tool with HD Polyurethane pad</p> <p>R40 New Age Smoothing Tool with Zeeko Blue Pad</p>

20. Accessories

20.1 Specialist Toolholders

Assembly	Part Number	Description
<p>Constant Force Toolholder (CFT) 12mm shank</p>  <p>If a STEP File is required, please email Zeeko info@zeeko.co.uk</p> <p>Zeeko's selection of Constant Force Tool Holders utilise latest precision air bushings to provide a linear range of motion to the tool head during machining operations.</p> <p>They have been designed specifically to work alongside our RPC machine range to counteract any vertical "Nodding", an issue often found in 6-axis robot arms, so that a near constant force can be applied at the polishing spot.</p> <p>We also see uses in parts with particularly large surface deviation, where the tool can follow any surface imperfections while still maintaining a similar polishing spot size.</p>	<p>YB100-000009</p>	<p>This CFT toolholder is normally only used with pitch tools, but can (with special tools and under special direction) be recommended for use with small SAG tools.</p> <p>It mounts directly to the front face of the 200/400 H-axis (with Schunk chuck removed). It requires dialing in to ensure correct performance. It is to be used with 12mm tool shafts (held in a collet)</p> <p>The Constant Force Tool Range currently has a variety of mounting options for machines and is constantly evolving as we improve existing designs and trial new ones.</p>
<p>Spring Loaded CFT for use with Pitch tools</p> 	<p>LB100-000007</p>	<p>Designed for use without an air supply, this Spring loaded CFT allows for pitch polishing on any machine tool capable of holding the 12mm shank. Various tip sizes (D) available from 3mm to 10mm.</p>

21. Safe Process Parameters

Teardrop (RT) – Standard ZephyrSAG Range				
	Parameter	Polyurethane	UNINAP	Zeeko Blue
	Track Spacing	0.04mm - 0.08 mm		
	Tool Offset	0.05mm - 0.2 mm		
	Tool Feed	100 – 3000 mm/min (IRP Machines)		
	Tool Spindle	50 – 2000 RPM (IRP Machines)		
	Parameter	Polyurethane	Resin	Nikel
	Track Spacing	0.14mm – 0.3mm	0.35mm	0.35mm
	Tool Offset	0.05mm – 0.3mm	0.35mm	0.35mm
	Tool Feed	100-3000 mm/min (IRP Machines)		
	Tool Spindle	50-2000 RPM (IRP Machines)		
R20 Bonnet 	Parameter	Polyurethane	Resin	Nikel
	Track Spacing	0.24 mm – 0.44 mm		
	Tool Offset	0.15 mm – 0.5 mm		
	Tool Feed	100-3000 mm/min (IRP Machines)		
	Tool Spindle	50-2000 RPM (IRP Machines)		
R40 Bonnet 	Parameter	Polyurethane	Uninap	Zeeko Blue
	Track Spacing	0.34 mm – 0.79 mm		
	Tool Offset	0.15 mm – 0.8 mm		
	Tool Feed	100-3000 mm/min (IRP Machines)		
	Tool Spindle	50 – 2000 RPM (IRP Machines)		
R80 Bonnet 	Parameter	Polyurethane	Uninap	Zeeko Blue
	Track Spacing	0.48 mm – 1.12 mm		
	Tool Offset	0.15 mm – 0.8 mm		
	Tool Feed	100-3000 mm/min (IRP Machines)		
	Tool Spindle	50 – 2000 RPM (IRP Machines)		

22. SAG Plus and Slurries for Super-polishing ($R_a \leq 2\text{nm}$)

SAG Plus – a Description of the Process

The SAG Plus process has been developed specifically as a high-speed pre-polishing process. A SAG Plus tool is designed to replace a bonnet tool with polyurethane polishing cloth (say LP66). Both are run with the same Cerium Oxide slurry normally used with the polyurethane alone and both processes facilitate the removal of the “grey” from a ground glass surface as a “pre-polishing” process.

As commented, the process is designed to replace the use of a polyurethane cloth. The SAG Plus tool should be used exactly as the polyurethane (LP66 or similar) would be used. The head speed, axis feeds and tool offsets can all be the same as when polyurethane is polishing.

The results will also be similar - (similar roughness and similar sub surface damage) - but the rate of removal will be approx. x3 what would be expected with polyurethane.

Care should be taken to maintain cleanliness standards, avoid slurry drop out, ensure the tool is kept well supplied with slurry even at extreme polishing angles

Whilst the process has been designed and developed to work on glass and glass only, already it has been found to work to a lesser degree on other materials - (for example – single crystal silicon). Users will very likely find other materials where it increases the removal rate without harming roughness or SSD expectations

The tools so far released are as below:

Tool Number (3um)	Tool Number (2um)	Tool Number (1um)
R10D3+RBDS12	R10D2+RBDS12	R10D1+RBDS12
R20D3+RBD	R20D2+RBD	R20D1+RBD
R40D3+RBD	R40D2+RBD	R40D1+RBD

NOTE - DIAMOND HAZARD: all opticians will react to the possible presence of occasional loose diamonds as they have a potential to scratch fine optical surfaces. Whilst no guarantees can be given, Zeeko has not seen any evidence of this hazard causing actual damage. This is most likely because of the small particle size of the worn diamond relative to the particle size of the slurry. But users should be mindful of this potential hazard and take care when a new glass type is polished as well as being extra vigilant at all times.

Slurries for Super-polishing ($R_a \leq 2\text{nm}$)

Zeeko manufactures and supplies a small number of specialist slurries now together with specialist accessories to make them easy to use. The slurries are:

- Zeeko Nano-slurry and
- Zeeko Super Nano-slurry

Both are colloidal silica slurries and so detailed instructions on their use can be provided together with the slurry. To optimise the performance of Zeeko Super Nano-slurry, follow these recommended steps:

Dilution: Dilute the Super Nano-slurry to a concentration of 20%. This ensures the appropriate weight fraction for your specific application.

pH Adjustment: Verify that the diluted Super Nano-slurry attains a pH level of 9.

Ultrasonication: Conduct a single run of ultrasonication. This step enhances the uniform dispersion of nanoparticles, promoting consistent results and improving the overall effectiveness of the slurry.

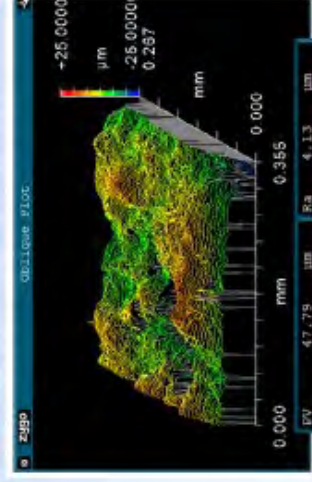
These instructions are designed to complement the exceptional qualities of Zeeko Super Nano-slurry, ensuring optimal polishing performance.

"SAG" Grinding of manufactured workpiece: Roughness

Finishing of titanium alloy (Ti4Al6V) component produced by Selective Laser Sintering.



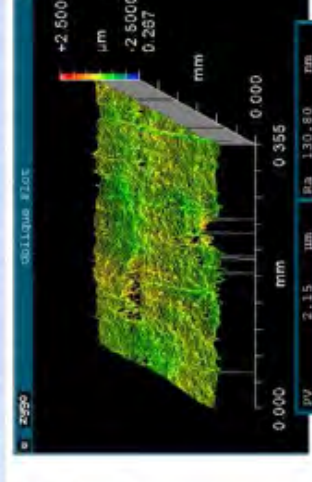
(a) As received



Roughness: **Ra 4130 nm**



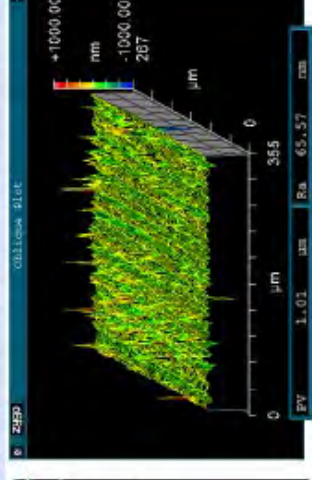
(b) Nickel bonded 40 μm



Ra 130 nm



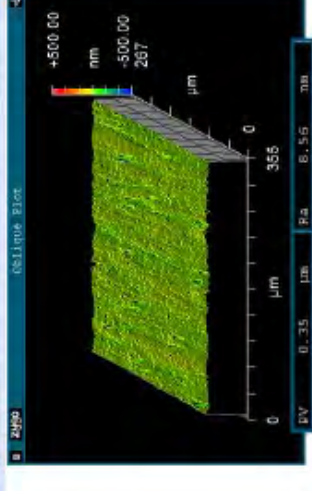
(c) Nickel bonded 9 μm



Ra 65 nm



(d) Resin bonded 3 μm

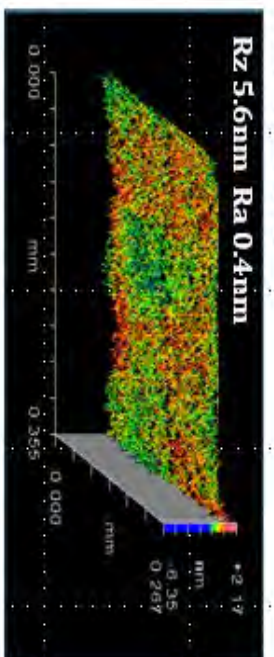
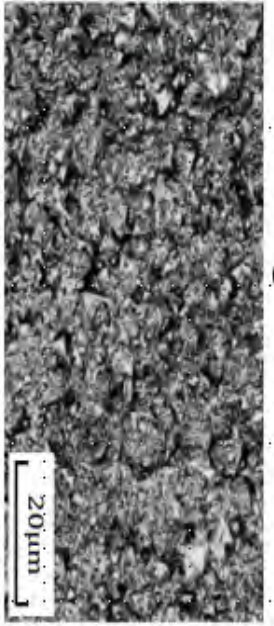


Ra 8 nm

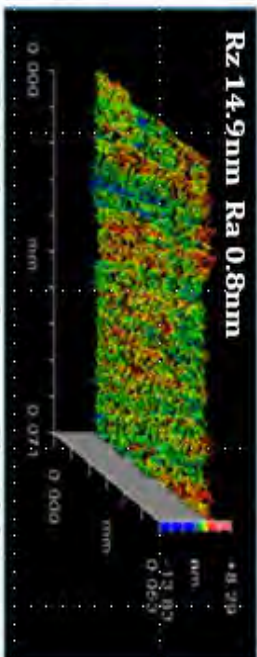
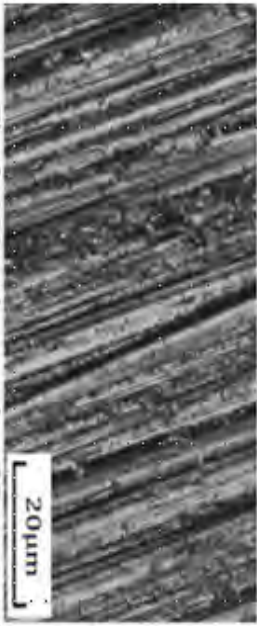
Starting Condition

SAG Finished Condition

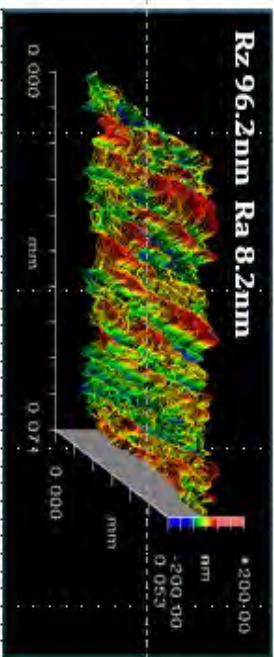
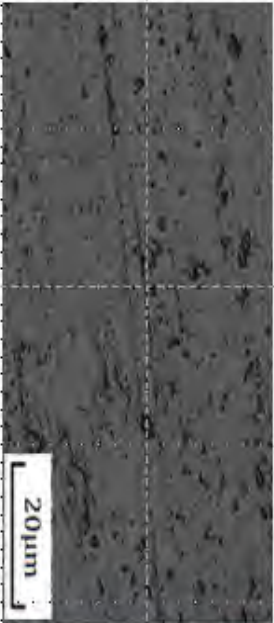
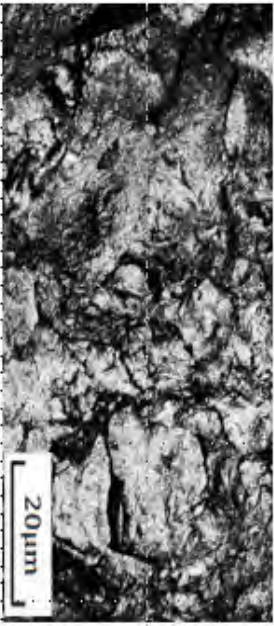
CVD SiC



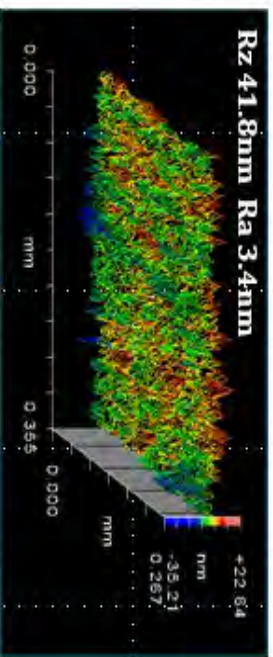
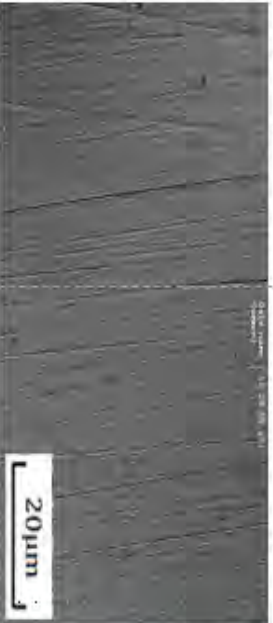
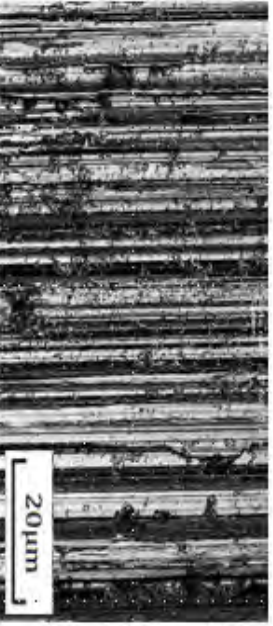
Stavax



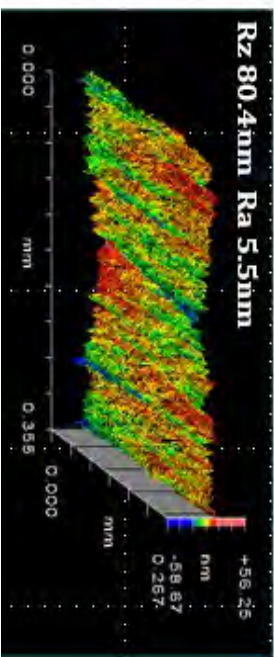
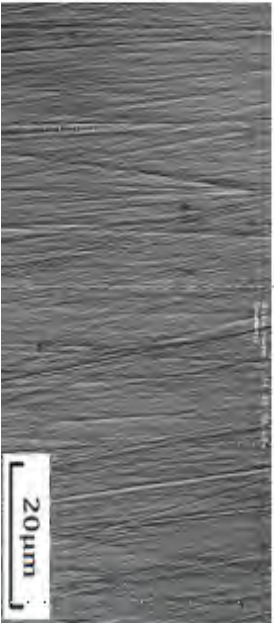
Ti6Al4V



Co-Cr



Inconel





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