

System 3R – Tooling

MacroVDP, MacroNano,

MacroHT & MacroInconel

Prepare for the future



Becoming better every day – since 1802

GF Machining Solutions

When all you need is everything, it's good to know that there is one company that you can count on to deliver complete solutions and services. From unmatched Electrical Discharge Machining (EDM), Laser texturing, Laser micromachining, Additive Manufacturing and first-class Milling and Spindles to Tooling and Automation, all of our solutions are backed by unrivaled Customer Services and expert GF Machining Solutions training. Our AgieCharmilles, Microlution, Mikron Mill, Liechti, Step-Tec and System 3R technologies help you raise your game—and our digital business solutions for intelligent manufacturing, offering embedded expertise and optimized production processes across all industries, increase your competitive edge.



+ We are System 3R.
We are GF Machining Solutions.

Prepare for the future with Macro

Vibration-damped palletisation (VDP)

Our VDP technology offers an over **30% higher removal rate, better surface finishes and reduced tool wear**. Furthermore, production time can be reduced by up to 30%. One obvious advantage of our VDP products is that they enable machining with more complex cutting data and tougher materials (e.g. titanium). In other words, they enable better exploitation of machine capacity.



MacroNano

Submicron is achievable with Nano. Our MacroNano and the MatrixNano systems are outstanding for submicron accuracy. System 3R was the market's first supplier of Nano tooling.
+ Consistent accuracy < 1 µm.



< 1 µm proven

MacroHT

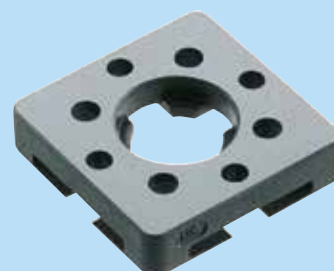
For use at high temperatures and ensuring that workpieces are correctly positioned in different processes (e.g. additive manufacturing). The MacroHT range comprises a number of chucks, reference elements and pallets that can be used at temperatures up to 230°C.



230°C

MacroInconel

For use at very high temperatures. Even in extremely hostile environments, using this Inconel reference element guarantees no shape changes at temperatures up to 800°C.



800°C



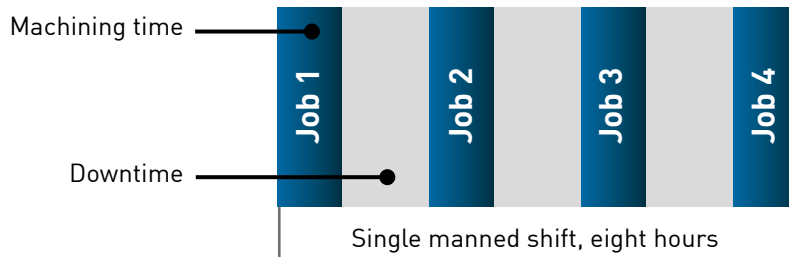
Experience has consistently shown that reducing a machine's downtime is significantly more worthwhile than chasing seconds in the actual machining process. A stable and exact reference system is the way to achieve this. It lets you preset away from the machine and then get it running with minimum downtime. Quickly and precisely!



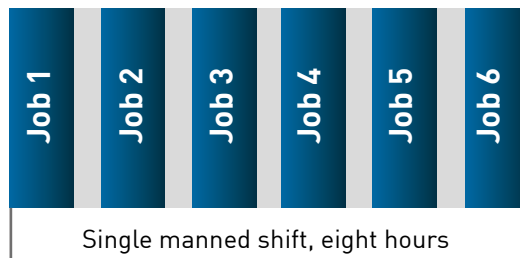
Fitting all your machines with the same reference system means that electrodes and workpieces can be moved between them without subsequent re-alignment and checking – **One Minute Set-up**.



Conventional setting-up



Pallet system



Higher productivity (calculation)

	Conventional setting-up	Pallet system
Working hours per day	8	8
Setting-up hours per day	- 4	- 0.5
Spindle hours per day	= 4	= 7.5
Working days per week	x 5	x5
Spindle hours per week	= 20	= 37.5

Faster payback (calculation)

	Conventional setting-up	Pallet system
Hourly invoicing (€)	50	50
Spindle hours per week	x 20	x 37,5
Weekly revenue (€)	= 1,000	= 1,875
Capital cost, machine (€)	150,000	150,000
Capital cost, pallet system (€)	0	+ 10,000
Total capital outlay (€)	= 150,000	= 160,000
Payback time (weeks)	150	85



A reference system minimises set-up times

Every minute converted from internal to external set-up time increases a machine's spindle time and business productivity.

Increased profitability is within your reach

A machine generates revenue when its spindle is turning. Your profitability depends on this.

Work smarter, not harder.

VDP (vibration-damped palletisation)

- + Reduces cutting forces by up to 25%. Lower cutting forces mean reduced power consumption and less tool wear.
- + Lengthens tool life by up to 30%, thereby lowering tool costs.
- + Lengthens the life of machine spindles. VDP also reduces machine spindle vibration, thereby extending spindle life by at least 30%.
- + Reduces lead times. VDP enables machining with higher cutting data. This puts 30% better utilisation of existing machine capacity within your reach.

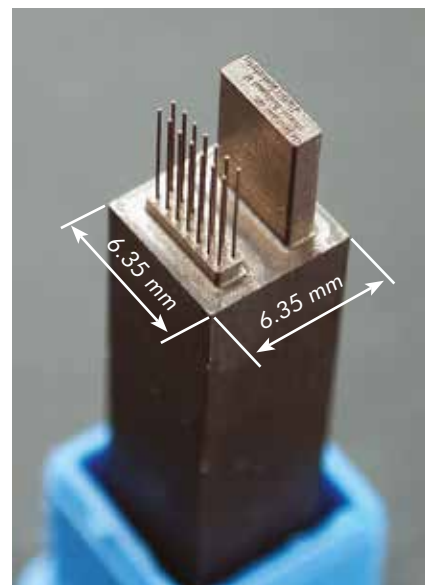
With conventional chucks, the dynamic forces arising from rotation and the action of the cutting tool cause workpiece vibration. Hence, to prevent instability and achieve the necessary surface quality, rotation speed and cutting-tool feed rate have to be restricted

Advantages of a damped chuck

After intensely researching chuck-system dynamics, System 3R developed and patented a chuck for vibration-damped palletisation (VDP). By reducing workpiece vibration, VDP improves the dynamics of the entire metal cutting process. Reduced workpiece vibration is passed on to the cutting tools themselves. This means that machine tools can be operated at higher speeds and with greater accuracy and less wear. To strict dimensional tolerances and with a surface quality in the micrometre range (a millionth of a metre), workpieces can usually be processed in a single operation.

- + **Higher material removal rate** improves productivity.
- + **Better surface finishes** reduce the need for extra processing.
- + **Less tool wear** extends cutting-tool life.
- + **Less vibration** in the machine spindle.
- + **Better dimensional accuracy** means fewer rejects.
- + **Greater scope** for machining difficult materials and complex shapes.
- + **Shorter lead times** thanks to the higher material removal rate.
- + **Lower machining noise.**

VDP[®]



Micro milling example

VDP advantages: The electrode Aspect Ratio (L/Ø) was doubled with VDP.

Dimensions: Ø = 0.134 mm, length = 4.8 mm.

Vibration-damped palletisation (VDP)

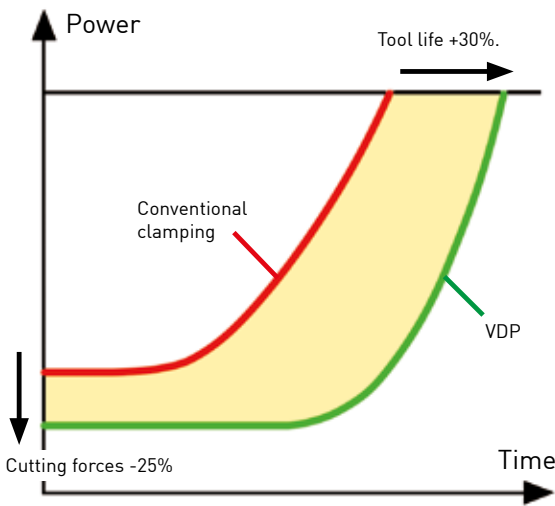
Increase your capacity by > 30%



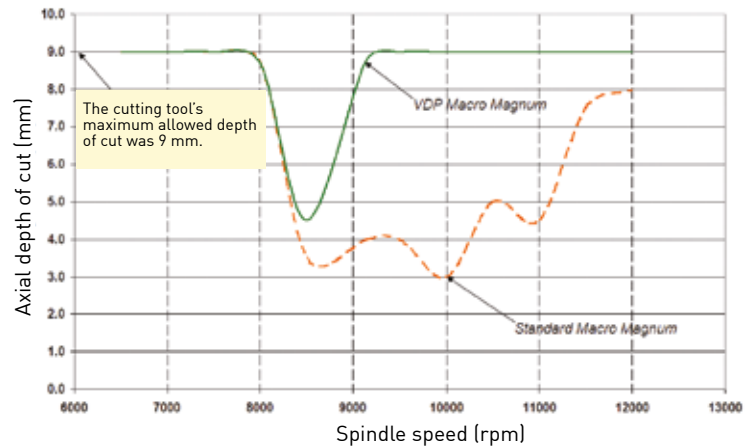
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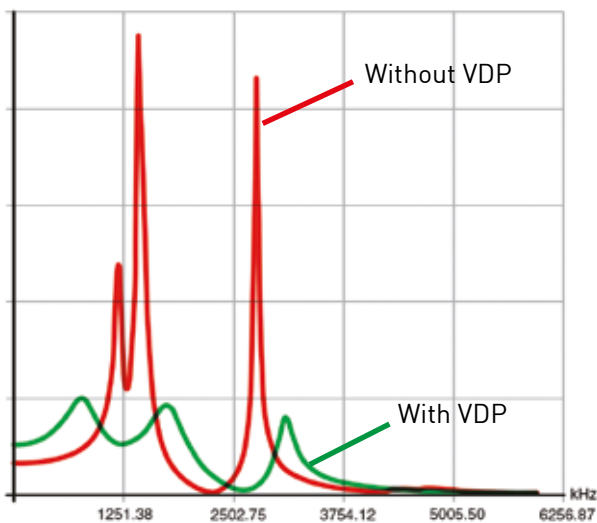
Reduced tool wear extends tool life = increased revenue.



Process stability analysis (Swiss machine tool manufacturer)

Cutting Speed (RPM)	Axial Depth of Cut (mm)		Increase in removal rate due to VDP (%)
	Magnum Std	Magnum VDP	
8,500	3.5	4.5	28.6
9,000	4.0	9.0*	125
10,000	3.0	9.0*	200

* Cut depth limited by the cutting tool for the test and not by VDP.



Graph showing oscillation amplitudes when machining with the workpiece clamped conventionally (without VDP) and in a damped chuck (with VDP).

MacroNano

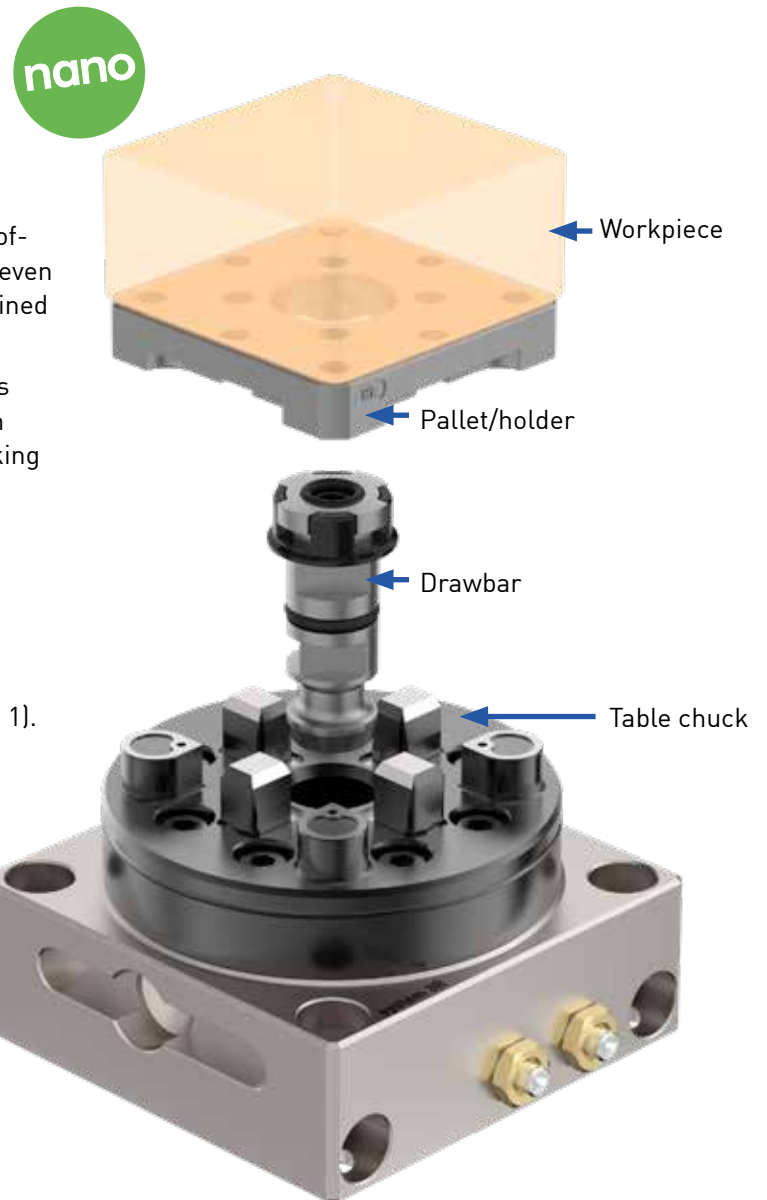
- + Extremely high accuracy.
- + Without detracting from the extreme accuracy, high-precision machines can be linked in the production chain.
- + Feedback to the machine for supplementary machining after inspection is possible. Such feedback is only meaningful if the pallet system is at least as accurate as the measuring machine.

Holding for nano precision

Nano-precision machining requires nano-precision referencing of workpieces and tools. Even with state-of-the-art solutions, this is a real challenge. It becomes even more challenging when references have to be determined in the shortest possible time.

Our MacroNano system is best described in two words – precise and quick! Via ultra-precise coupling of both workpiece and tool clamping, the system ensures linking throughout the entire production chain.

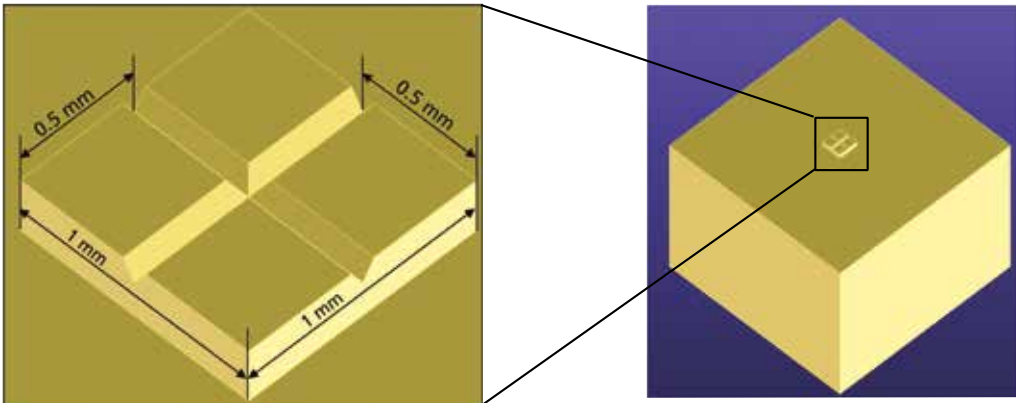
- + Repetition accuracy – within 0.001 mm.
- + Locking force – 6,000 N.
- + Fixed index positions – 4 x 90°.
- + Required air pressure, pneumatic chuck – 6 bars (± 1).
- + Recommended max. workpiece weight – 50 kg.



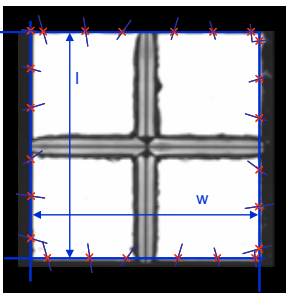
MacroNano

Application example: Microstructuring with Diamond Machining

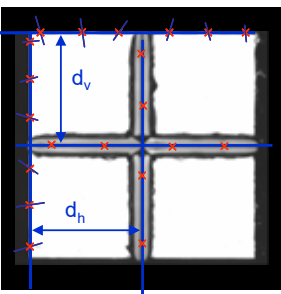
Micro features produced to nano precision



This microstructure was produced using two different diamond flycutting machines. Each was equipped with a MacroNano chuck and use was made of the MacroNano system's indexing feature. The square in the middle of the workpiece (picture on the right) was produced by plane milling on the 1st machine. To produce the microgrooves, the pallet carrying the workpiece was then transferred to the 2nd machine's chuck. The zero reference was determined only once on the 1st machine. Thanks to the MacroNano system's precision (indexing included therein), it was then carried throughout the entire process chain. Overall structure deviation was less than 0.5 microns..



Cube dimension measurement

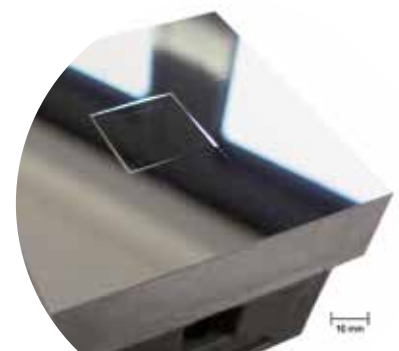
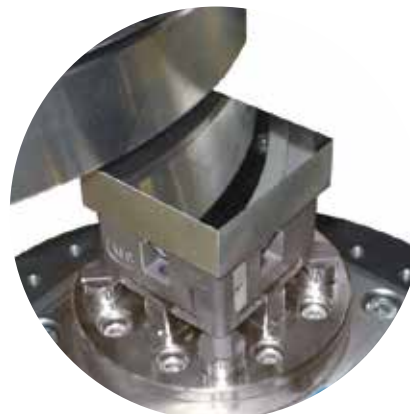


Groove position measurement

	Width (mm)	Length (mm)	Vertical dist. (mm)	Horizontal dist. (mm)
w ₁	0.9996	l ₁ 0.9999	d _{v1} 0.4988	d _{h1} 0.5013
w ₂	0.9996	l ₂ 0.9999	d _{v2} 0.4993	d _{h2} 0.4995
w ₃	0.9996	l ₃ 0.9999	d _{v3} 0.4996	d _{h3} 0.5001
w ₄	0.9997	l ₄ 0.9999	d _{v4} 0.4991	d _{h4} 0.4995
w ₅	0.9996	l ₅ 0.9998	d _{v5} 0.5010	d _{h5} 0.5001
w ₆	0.9996	l ₆ 0.9998	d _{v6} 0.5007	d _{h6} 0.5002
w ₇	0.9997	l ₇ 0.9999	d _{v7} 0.4996	d _{h7} 0.5012
w ₈	0.9996	l ₈ 0.9999	d _{v8} 0.4992	d _{h8} 0.5009
w ₉	0.9997	l ₉ 0.9999	d _{v9} 0.4996	d _{h9} 0.5009
w ₁₀	0.9996	l ₁₀ 0.9998	d _{v10} 0.4998	d _{h10} 0.5008
w	0.9996	l 0.9999	d_v 0.4997	d_h 0.5004

Mean values

Overall structure deviation < 0.5 μm



MacroDiabas

When requirements for **minimal thermal expansion** are extreme, a MacroDiabas chuck is ideal. This is because the chuck material (diabase) handles variations in ambient temperature exceedingly well.



230° C

MacroHT

In additive manufacturing, it is a good idea to process directly on a reference element any workpiece that is to have more work (e.g. milling, grinding, etc.) later in production. This can result in less material having to be removed. With MacroHT, these benefits are gained at temperatures up to 230°C.

MacroInconel

For use at very high temperatures we offer Macro reference elements in Inconel. To be used in, for example, ECM* machines. With workpieces the Inconel reference elements guarantees no shape changes at temperatures up to 800°C.

*Electro-Chemical Machining.



800° C



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Losone
Geneva
Flawil
Langnau

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