

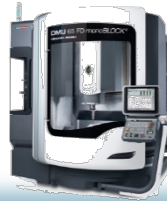
Machine Tools at Fraunhofer IPT
Department: High Performance Cutting
Viktor Rudel, M.Sc., Aachen

High Performance Cutting

Machines & Equipment at Fraunhofer IPT



Mikron HPM 800U HD



DMG MORI DMU65 FD



Hermle C42 MT



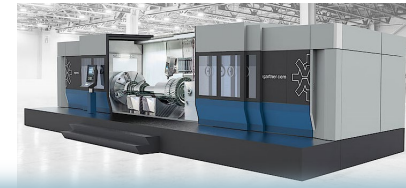
Makino D500



Alzmetall GX 1000/5-FDT



GROB G550T



Weingärtner mpmc 1000 L - 3000



Makino iQ500



KERN Micro



Walter Helitronic Vision 400



Walter Helicheck Plus



Orthogonal Cutting

Source: GF Machining Solutions; DMG MORI; Maschinenfabrik Berthold HERMLE AG; MAKINO; ALZMETALL GmbH & Co. KG; GROB-WERKE GmbH & Co. KG; Weingärtner Maschinenbau GmbH; KERN Microtechnik; Walter Maschinenbau GmbH

Mikron HPM 800U

5-axis milling-turning machining center



Tool spindle (HSK-A63)

Max. spindle speed	20,000	1/min
Max. power	39	kW

Workpiece range

Max. workpiece diameter	800	mm
Max. workpiece weight	600	kg

Machine axes data

Max. linear axis speed (X/Y/Z)	60/60/60	m/min
Max. revolution in C-axis	60	1/min
Swivel axis range in A-axis	+91/-121	°
Swivel axis range in C-axis	endless	°
3-axis positioning accuracy	<8	µm

Machine Controller

NC: Siemens SINUMERIK 840D sl
PLC: Siemens SIMATIC S7-400

Further features & digital equipment

- + Internal cooling (70 bar)
- + Toolscope Data Acquisition
- + All rotary axes with direct drives
- + gemineers Data Acquisition
- + Siemens Industrial Edge
- + 3D Form Inspect
- + OPC-UA output

Source: GF Machining Solutions

DMG DMU 65 FD monoBLOCK

5-axis milling-turning machining center



Tool spindle (HSK-A63)

Max. spindle speed	20,000	1/min
Max. power (100% / 40% ED)	25/35	kW

Workpiece range

Max. workpiece diameter	650	mm
Max. workpiece weight	600	kg

Machine axes data

Max. linear axis speed (X/Y/Z)	40/40/40	m/min
Max. revolution in C-axis	1000	1/min
Swivel axis range in A-axis	+/-120	°
Swivel axis range in C-axis	endless	°
3-axis positioning accuracy	<6	µm

Machine Controller

NC: Siemens SINUMERIK 840D sl
PLC: Siemens SIMATIC S7-400

Further features & digital equipment

+ Internal cooling (80 bar)
+ TCC - Tool Control Center
+ Integrated cycles for power skiving
+ Renishaw SPRINT - OSP60
+ gemineers Data Acquisition
+ eM machines Liquid mate
+ Janitza Electrical Consumption Measurement
+ DMG Mori Adaptive Coolant Flow

Source: DMG MORI

Hermle C42 MT

5-axis milling-turning machining center



Tool spindle (HSK-T63)

Max. spindle speed	18,000	1/min
Max. power (100% / 20% ED)	25/42	kW

Workpiece range

Max. workpiece diameter	800	mm
Max. workpiece weight	700	kg

Machine axes data

Max. linear axis speed (X/Y/Z)	45/45/40	m/min
Max. revolution in C-axis	800	1/min
Swivel axis range in A-axis	+/-130	°
Swivel axis range in C-axis	endless	°
3-axis positioning accuracy	<5	µm

Machine Controller

NC: Siemens SINUMERIK 840D sl
PLC: Siemens SIMATIC S7-400

Further features & digital equipment

+ Internal cooling (80 bar)
+ Thermal Stabilizer System for all axis
+ All rotary axes with direct drives
+ Renishaw SPRINT - OSP60
+ gemineers Data Acquisition, Toolscope Data Acquisition
+ Will-Fill system for coolant condition monitoring and control
+ External Electric Cabinet with Sensory: 11x Acceleration, 11x Acoustic Emission, 3x FPGA Processing Units

Source: Maschinenfabrik Berthold HERMLE AG

Makino D500

5-axis milling machining center



Tool spindle (HSK-A63)

Max. spindle speed	20,000	1/min
Max. power (30min/contin.)	18.5/15	kW

Workpiece range

Max. workpiece diameter	650	mm
Max. workpiece weight	350	kg

Machine axes data

Max. linear axis speed (X/Y/Z)	48/40/50	m/min
Max. revolution in C-axis	50	1/min
Swivel axis range in A-axis	+30/-120	°
Swivel axis range in C-axis	endless	°
3-axis positioning accuracy	<1.5	µm

Machine Controller

NC: FANUC 31i

PLC:

Further features & digital equipment

- + IFM Air Consumption sensor
- + Thermal Stabilizer System for all axis
- + gemineers Data Acquisition
- + Internal cooling (70 bar)
- + 3D Form Inspect

Source: MAKINO

Alzmetall GX 1000/5-FDT

5-axis milling-turning machining center



Tool spindle (HSK-A63)

Max. spindle speed	18,000	1/min
Max. power	25	kW

Workpiece range

Max. workpiece diameter	930	mm
Max. workpiece weight	250	kg

Machine axes data

Max. linear axis speed (X/Y/Z)	60	m/min
Max. revolution in C-axis	1100	1/min
Swivel axis range in A-axis	+/-140	°
Swivel axis range in C-axis	endless	°
3-axis positioning accuracy	<7	µm

Machine Controller

NC: Siemens SINUMERIK 840D pl
PLC: Siemens SIMATIC S7-300

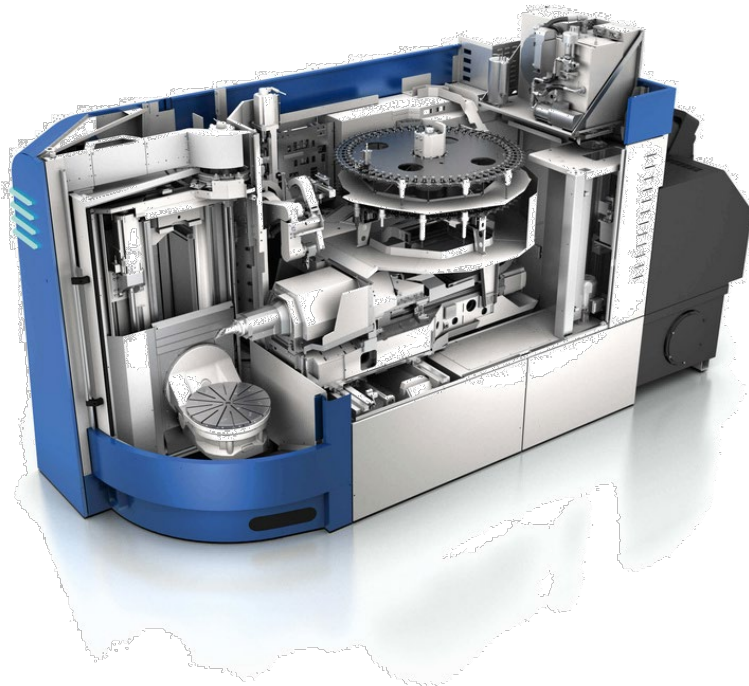
Further features & digital equipment

- + Internal cooling (70 bar)
- + All rotary axes with direct drives
- + 3D Form Inspect

Source: ALZMETALL GmbH

Grob 552T

5-axis milling-turning machining center



Tool spindle (HSK-T100)

Max. spindle speed	14,500	1/min
Max. power (100% /40%)	50/58	kW

Workpiece range

Max. workpiece diameter	950	mm
Max. workpiece weight	600	kg

Machine axes data

Max. linear axis speed (X/Y/Z)	65/50/80	m/min
Max. revolution in B-axis	800	1/min
Swivel axis range in A-axis	+45/-185	°
Swivel axis range in B-axis	endless	°
3-axis positioning accuracy	<6	µm

Machine Controller

NC: Siemens SINUMERIK ONE
PLC: Siemens SIMATIC S7-1200

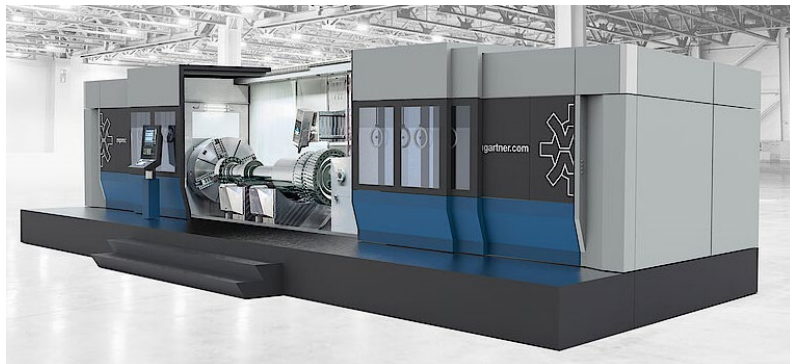
Further features & digital equipment

+ Renishaw Sprint OSP60
+ Thermal Stabilizer System for all axis
+ Horizontal design for chip fall
+ Power skiving
+ gemineers Data Acquisition
+ Siemens SENTRON Power Monitoring
+ RotoClear 4k interior Monitoring
+ LiquidTool Coolant Analysis

Source: GROB-WERKE GmbH & Co. KG

Weingärtner mpmc 1000 L - 3000

Modular inclined bed turning and milling machine



Main spindle / Counter spindle

Max. spindle speed	1,600 / 2,400	1/min
Max. power	88 / 64	kW
Max. torque	7,706 / 1,300	Nm

Workpiece range

Max. workpiece diameter	1,000	mm
Max. workpiece length	3,000	mm
Max. workpiece weight	3,000	kg

Milling spindle (Capto C8)

Max. spindle speed	14,000	1/min
Max. power	70	kW
Max. torque	430	Nm

Machine Controller

NC: Siemens SINUMERIK ONE
PLC: Siemens SIMATIC S7-1200

Further features & digital equipment

+ Renishaw Sprint OSP60
+ Thermal Stabilizer System for all axis
+ LiquidTool Coolant Analysis
+ Power skiving
+ gemineers Data Acquisition
+ Siemens SENTRON Power Monitoring
+ Internal cooling (80 bar)
+ Tool magazine for 60 tools

Source: Weingärtner Maschinenbau GmbH

Makino iQ500

3-axis micro milling machining center



Tool spindle (HSK-E32)			Machine Controller	
Max. spindle speed	400 - 45,000	1/min	NC: FANUC 31i, Pro 6	
			PLC: -	
Workpiece range			Further features & digital equipment	
Max. workpiece dimensions	755x500x300	mm	+ gemineers Data Acquisition	
Max. workpiece weight	300	kg	+ BIG Air Turbinespindle 80,000 1/min	
Machine axes data			+ OPC-UA output	
Max. linear axis speed (X/Y/Z)	16/16/8	m/min	+ Mirror Surface finish	
Travel path (X/Y/Z)	600/500/300	mm		

Source: MAKINO

KERN Micro

5-axis micro milling machining center

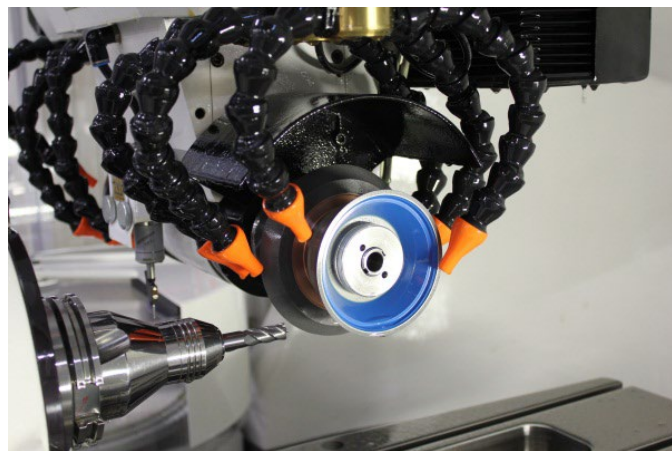


Tool spindle (HSK 40)			Machine Controller	
Max. spindle speed	42,000	1/min	NC: Heidenhain iTNC 530	
Max. power	15	kW	PLC:	
Workpiece range			Further features & digital equipment	
Max. workpiece diameter	350	mm	+ Machine-integrated component measurement	
Max. workpiece weight	50	kg	+ 80 bar high-pressure pump for internal cooling	
Machine axes data			+ Direct drive on all rotary axes	
Max. linear axis speed (X/Y/Z)	30	m/min		
Max. revolution in C-axis	100	1/min		
Swivel axis range in A-axis	+45/-185	°		
Swivel axis range in C-axis	endless	°		
3-axis positioning accuracy	<3	µm		

Source: KERN Microtechnik

Walter Helitronic Vision 400

High-performance tool grinding machine



Tool spindle (SK 50)

Max. spindle speed	10,500	1/min
Max. power	24	kW
Max. grinding wheel diameter	254	mm

Workpiece range

Max. workpiece length - peripheral	350	mm
Max. workpiece length - face	250	mm
Max. workpiece weight	50	kg

Machine Controller

NC: FANUC 31i

PLC:

Further features & digital equipment

- + Data link to the Helicheck Plus measuring machine
- + integrated erosion unit for eroding tools
- + Steady rest insert for workpiece support
- + HELITRONIC TOOL STUDIO grinding software
- + Extension by 6-axis CNC handling robot possible

Source: Walter Maschinenbau GmbH

Walter Helicheck Plus

4-axis CNC measuring machine for complete measurement of cutting tools



Measurable tools		Machine Controller
Range of tool diameter	200 mm	NC: -
Max. tool length	300 mm	PLC: -
Max. tool weight	25 kg	
Measuring accuracy		Measurement system
Repeatability	<1 µm	Optical system with four permanently installed CCD cameras
Measurement resolution	0.25 µm	

Source: Walter Maschinenbau GmbH

Fraunhofer IPT

Highly dynamic linear test rig for systematic machinability investigations



Basic function

Reproduction of complex, real milling processes through analogy investigation with optimum access to the cutting zone

Further features & digital equipment

Force measuring platform: Acquisition of cutting force components

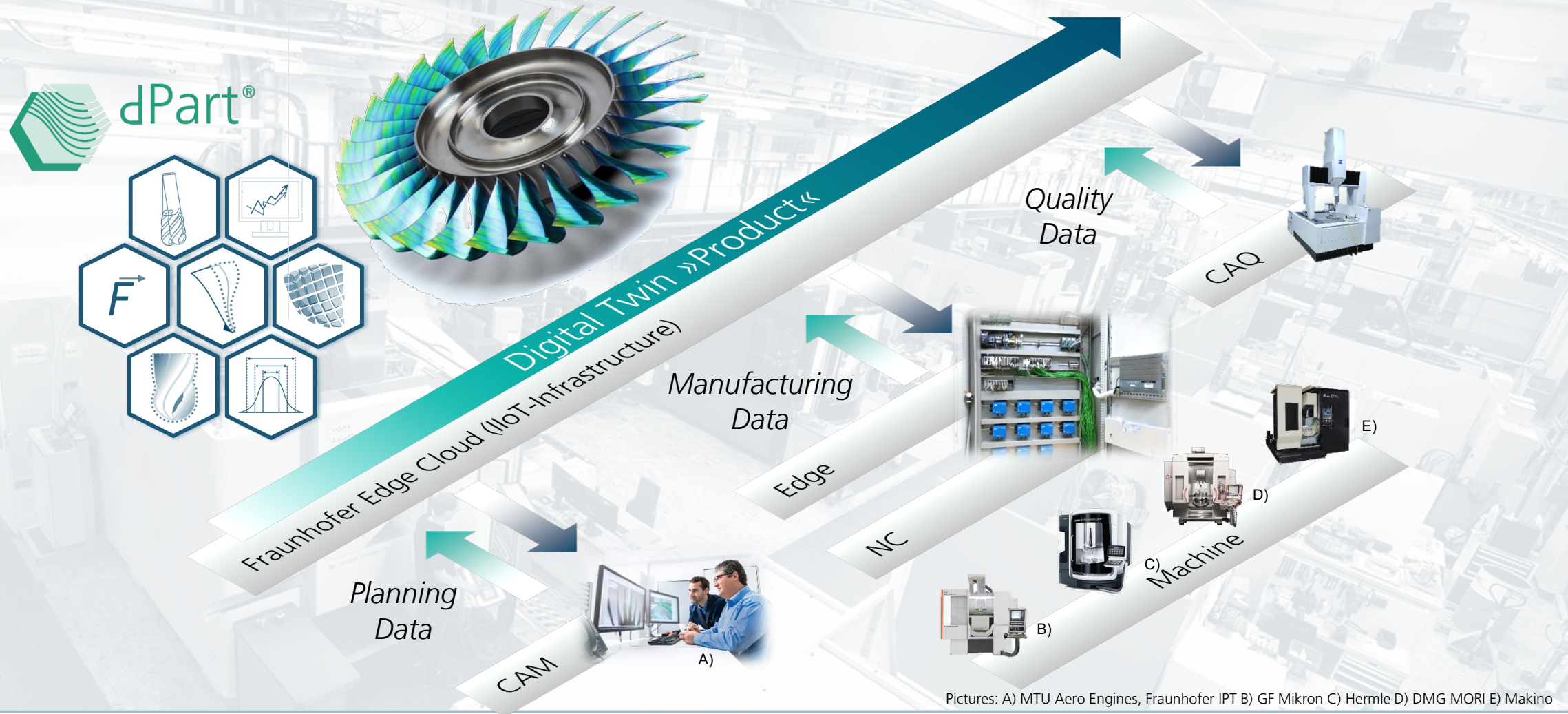
High speed camera: Visualization of chip formation processes

Thermographic camera: Measurement of heat transfer and temperature gradients

Ultrasonic unit for generation of tool ultrasonic oriented in the cutting direction

Core Competence of High Performance Cutting Department

Digital Process Chain & Prototype Manufacturing



Your Contact



Viktor Rudel M.Sc.

Head of Department

Fraunhofer-Institute for Production Technology IPT
Steinbachstr.17
52074 Aachen

☎ +49 241 8904-316

✉ viktor.rudel@ipt.fraunhofer.de