INNOLITE

MACHINES

ALIGNMENT TURNING
ULTRA-PRECISION
ULTRASONIC SYSTEMS

www.innolite.de

DRIVING PRODUCTIVITY IN ULTRA-PRECISION TECHNOLOGY

This motto has been guiding us in developing ultra-precision machine tools for the past 15 years, continuously improving and constantly developing the system performance together with our customers.

We intend to build highest quality standard modular platforms with customer specific adaptations to enhance accuracy, productivity and technical capabilities. We want to understand your ultra-precision challenge, configure and supply the best possible production solution and support you during your successful production.

INNOLITE

THIS IS INNOLITE

DESIGN PRINCIPLES

Highest mechanical volumetric accuracy is key to our machine designs. All machines are based on hand lapped natural granite beds and our own ultra-low gap hydrostatics. The entire supply periphery for pressurized oil, tempered water or air are based on our proprietary designs. They are integrated in our machine control system for tightest stability down to the 10 milliKelvin or Bar-range. We understand our machines as mechatronic systems – a close interaction between mechanics and outstanding control system concepts. Our FPGA based drives allow for 100 kHz control loop concepts, advanced compensation and dynamic optimization based on modern simulation techniques. Understanding and optimizing the three aspects of mechanics, thermal performance and control system technology we constantly seek to develop the most performing ultra-precision platforms.

NANOGRIP

Interfacing at sub-micron accuracy is a decisive key to productivity in ultra-precision technology. Our industry proven NanoGrip allows for the clamping of tools, workpieces, our system modules, sensors or fixtures at highest stiffness with a repeatability of down to 0.5 µm. Mounted to the spindle, it spins up to 6,000 rpm. As an interface, NanoGrip can feed through vacuum or other media. It enables our customers to design part specific fixtures, to set up process chains consisting of accurate pre-machining and time-optimized diamond machining steps. It allows for highly productive machining and off-line measurement steps eliminating parts alignment. NanoGrip has been a mandatory item in the conception of all our machines.

DIRECTDRIVE3D

DirectDrive3D replaces the online calculation of a CNC controller interpolating CAD/CAM set points into motion profiles of individual machine axes. We have taken this step to an off-line pre-calculation with an unmatched set point resolution of 10.000 fixed points per second for all interpolating axes exceeding state of art by factors of 5 to 10. Our performing software and hardware allows for pre-calculated programs with sizes up to several Gigabytes that can be directly streamed to the decentralized FPGA based servo drives working at a position and current control loop of 100 kHz. In addition to the outstanding resolution the pre-calculation allows us to do intensive analysis and optimization prior to machining of your challenging workpiece.

IL200 DYNAMIC. EFFICIENT. COST EFFECTIVE.

Consistent development of the Innolite machine technology to continuously increase precision have led to the new type of IL200. It's a small compact and highly efficient machine for mold pins, ophthalmic products or any other ultra-high accuracy small parts. Due to it's compact design with low Abbé errors we achieve sub-nanometer following errors in our linear axes and surface finishes as low as < 0.5 nm. An integrated air conditioning systems as well as an active water and oil temperature and pressure control allow for long term stability and best repeatability. With our DirectDrive3D technology, the IL200 achieves unmatched free for machining performance even without our overdrive axes.

IL200 GENERAL	
System Configuration	Ultra precision 3 axes (XZW) CNC high dynamic machining center
Machine Base	Natural granite base for excellent accuracy
Vibration Isolation	Self leveling pneumatic isolation system (option: passive or electronically controlled active leveling)
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear (0.01 nm optional), 0.0000001° rotary
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 300 l/min, 10 µm prefiltered; Electrical: 400 V, 16 A, 50/60 Hz; Water: 8-10 °C, 30 l/ min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size	2,520 * 1,120 * 2,020 (D * W * H)
Standalone Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Z-AXIS
Travel	200 mm	200 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	8,000 mm/min	8,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor
Static Stiffness	380 N/µm vertical	420 N/µm vertical
Media supply	Compact integrated hydrostatic supply unit, low pulsation	

ROTARY AXES	C-AXIS
Type	Workholding Spindle; groove compensated air bearing
Radial load capacity	70 kg at 6.9 bar (radial)
Axial load capacity	228 N/µm
Radial stiffness	98 N/µm at 6.9 bar
Axial stiffness	< 15 nm
Motion accuracy radial	< 15 nm
Velocity control	< 10,000 rpm
Position control	0-3,000 rpm
Feedback Resolution	0.008 arcsec
Thermal Control	Integrated cooling
Interface	NanoGrip

METROLOGY | LVDT (OPTION)		METROLOGY | CONFOCAL PROBE (OPTION)	
2D Surface Line Scan	Air bearing LVDT probe for compensation	Measurement of Optical Surface	Scanning chromatic confocal probe
Working Distance / Range	0.5 mm	Working Distance / Range	6 mm / 0.3 mm
Resolution	< 10 nm	Resolution of Sensor	< 10 nm
Stylus Tip	Ruby, diamond	Data Acquisition	1,000 pts/sec in spiral or orbit scan, full surface

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

ILSONIC (OPTION)	OVERDRIVE 20/6 (OPTION)
Transversal ultrasonic unit for diamond turning of steel	High dynamic axis for freeform generation, aerostatic bearing
Working Frequency: 100 kHz	Total travel: 20 mm/6 mm
Max. Depth for Concave Parts: 70 mm	Max. acceleration: 20 G/40 G
NanoGrip Interface to Machine	Drive: Linear Motor/Voice Coil
55° Insert tool, monocrystalline diamond	Feedback: encoder resolution 0.03125 nm
	CNC Standard Integration DirectDrive3D

PART	GENERAL DESCRIPTION
Size	Ø < 200 mm; length < 130 mm
Turning performance	Form accuracy (PV) < 0.1 µm; surface roughness (Ra) < 1 nm
Overdrive freeform HUD	200 * 200 mm; total stroke 2.1 mm; form accuracy (PV) < 0.5 µm; machining time 3.5 h

IL300 FLEXIBLE. PRODUCTIVE. ALLROUNDER.

The IL300 is the leading ultra-precision diamond lathe for highly productive, highly flexible optics manufacturing. It was developed to increase productivity in ultra-precision technology. Consistently integrated zero-point clamping systems with submicron accuracy, a stainless-steel housing and a highly dynamic lightweight construction for maximum dynamics. The applications range from standard diamond turning to free-form manufacturing and microstructure generation to diamond turning of steel and infrared materials with ultrasonic support (ILSONIC).

IL300 GENERAL	
System Configuration	Ultra precision 3-5 axes (XZC;B;W) CNC high dynamic machining center
Machine Base	Natural granite base for excellent accuracy
Vibration Isolation	Self leveling pneumatic isolation system (option: passive or electronically controlled active leveling)
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear (0.01 nm optional), 0.0000001° rotary
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 300 l/min, 10 µm prefiltered; Electrical: 400 V, 16 A, 50/60 Hz; Water: 8-10 °C, 30 l/min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size	2000 * 1600 * 2100 mm (D * W * H)
Air conditioner Size Standalone	510 * 1100 * 740 mm (D * W * H)
Standalone Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Z-AXIS
Travel	300 mm	300 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	3,000 mm/min	6,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor
Static Stiffness	420 N/µm vertical	420 N/µm vertical
Media supply	Compact integrated hydrostatic supply unit, low pulsation	

ROTARY AXES	C-AXIS	B-AXIS (OPTION)
Type	Workholding Spindle; groove compensated air bearing	Oil hydrostatic axis, 360° continuous
Load Capacity	70 kg at 6.9 bar (radial)	< 300 kg (axial)
Axial Stiffness	228 N/µm	370 N/µm
Radial stiffness	98 N/µm at 6.9 bar	125 N/µm
Motion Accuracy Axial	< 15 nm	< 50 nm
Motion Accuracy Radial	< 15 nm	< 80 nm
Velocity Control	< 10,000 rpm	
Position Control	0-3,000 rpm	20 rpm
Feedback Resolution	0.008 arcsec	0.005 arcsec
Thermal Control	Integrated cooling	Integrated cooling
Interface	NanoGrip	NanoGrip

METROLOGY | LVDT (OPTION)		METROLOGY | CONFOCAL PROBE (OPTION)	
2D Surface Line Scan	Air bearing LVDT probe for compensation	Measurement of Optical Surface	Scanning chromatic confocal probe
Working Distance / Range	0.5 mm	Working Distance / Range	6 mm / 0.3 mm
Resolution	< 10 nm	Resolution of Sensor	< 10 nm
Stylus Tip	Ruby, diamond	Data Acquisition	1,000 pts/sec in spiral or orbit scan, full surface

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

ILSONIC (OPTION)	OVERDRIVE 20/6 (OPTION)
Transversal ultrasonic unit for diamond turning of steel	High dynamic axis for freeform generation, aerostatic bearing
Working Frequency: 100 kHz	Total travel: 20 mm / 6 mm
Max. Depth for Concave Parts: 70 mm	Max. acceleration: 20 G / 40 G
NanoGrip Interface to Machine	Drive: Linear Motor / Voice Coil
55° Insert tool, monocrystalline diamond	Feedback: encoder resolution 0.03125 nm
	CNC Standard Integration DirectDrive3D

PART	GENERAL DESCRIPTION
Size	Ø < 300 mm; length < 250 mm
Turning performance	Form accuracy (PV) < 0.1 µm; Surface roughness (Ra) < 1 nm
Overdrive Tilted Plane	Ø < 100 mm; angle 3°; form accuracy (PV) < 0.2 µm
Overdrive Freeform HUD	250 * 200 mm; total stroke 2.1 mm; form accuracy (PV) < 0.5 µm; machining time 3.5 h

IL400L LASER. SAFETY. NEXT LEVEL.

The IL400L is the first ultra-precision machine designed for next level laser processing of brittle materials beyond conventional diamond turning. It's unique certified laser safety concept allows for autonomous and automated machine operation of up to 8.5 hours. It combines the new Innolite selective laser etching process (ILSLE) of fused silica with femto second lasers, direct ablation based on polar kinematics and laser assisted diamond machining with ILPAC. Due to the consequent FPGA based laser control system integration, the platform is designed for continuous laser parameter adjustment at 10kHz. A deterministic surface energy input up to the center of the part can be freely programmed with the newly extended ILCAM control software. The IL400L paves the way for next level ultra-precision machining.

IL400L GENERAL	
System Configuration	Ultra precision 3-5 axes (XZC;B;W) CNC high dynamic machining center
Machine Base	Natural granite base for excellent accuracy
Vibration Isolation	Self leveling pneumatic isolation system (option: passive or electronically controlled active leveling)
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear (0.01 nm optional), 0.0000001° rotary
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 300 l/min, 10 µm prefiltered; Electrical: 400 V, 32 A, 50/60 Hz; Water: 8-10 °C, 30 l/min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size	1500 * 3100 * 2100 mm (D * W * H)
Standalone Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Z-AXIS
Travel	400 mm	300 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	3,000 mm/min	6,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor
Static Stiffness	420 N/µm vertical	420 N/µm vertical
Media supply	Compact integrated hydrostatic supply unit, low pulsation	

ROTARY AXES	C-AXIS
Type	Workholding Spindle; groove compensated air bearing
Load Capacity	70 kg at 6.9 bar (radial)
Axial Stiffness	228 N/µm
Radial stiffness	98 N/µm at 6.9 bar
Motion Accuracy Axial	< 15 nm
Motion Accuracy Radial	< 15 nm
Velocity Control	< 10,000 rpm
Position Control	0-3,000 rpm
Feedback Resolution	0.008 arcsec
Thermal Control	Integrated cooling
Interface	NanoGrip

METROLOGY | LVDT (OPTION)		METROLOGY | CONFOCAL PROBE (OPTION)	
2D Surface Line Scan	Air bearing LVDT probe for compensation	Measurement of Optical Surface	Scanning chromatic confocal probe
Working Distance / Range	0.5 mm	Working Distance / Range	6 mm / 0.3 mm
Resolution	< 10 nm	Resolution of Sensor	< 10 nm
Stylus Tip	Ruby, diamond	Data Acquisition	1,000 pts/sec in spiral or orbit scan, full surface

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

ILSONIC (OPTION)	OVERDRIVE (OPTION)
Transversal ultrasonic unit for diamond turning of steel	High dynamic axis for freeform generation, hydrostatic bearing
Working Frequency: 100 kHz	Total travel: 20 mm
Max. Depth for Concave Parts: 70 mm	Max. acceleration: 20 G
NanoGrip Interface to Machine	Drive: Linear Motor
55° Insert tool, monocrystalline diamond	Feedback: encoder resolution 0.03125 nm
	CNC Standard Integration DirectDrive3D

FEMTO SECOND LASER	DIODE LASER
ILSLE Processes	ILPAC Laser assisted turning
fs-InnoSlab laser	
λ = 1030 nm	λ = 960 nm
Power: 7 MHz, 50 W	Power : 30 W / 50 W
Max. frequency: 50 MHz	Mode: CW / Modulated
M2 < 1.3	Modulation frequency 50 kHz

PART	GENERAL DESCRIPTION
Size	Ø < 240 mm; length < 250 mm
Turning performance	Form accuracy (PV) < 0.1 µm; Surface roughness (Ra) < 1 nm
Overdrive Tilted Plane	Ø < 100 mm; angle 3°; form accuracy (PV) < 0.2 µm
Overdrive Freeform HUD	240 * 200 mm; total stroke 2.1 mm; form accuracy (PV) < 0.5 µm; machining time 3.5 h

IL500 LARGE SCALE. PROCESS COMBINATION. AUTOMATION.

In addition to large components with diameters of up to 500 mm, the IL500 offers unique options for simultaneous process equipment or parallelization of processes. With three or four ultra-precision axes, spherical, free-form and also micro-structured optics can be efficiently manufactured. Integrated measurement technology enables the inline characterization of surfaces with direct compensation. In this way, preprocessing steps and ultra-precise finishing can be efficiently combined with the highest levels of accuracy. Prepared for loading with robots, the machine is the ideal platform for automated series production.

IL500 GENERAL	
System Configuration	Ultra precision 3-5 axes (XZC;B;W) CNC high dynamic machining center
Machine Base	Natural granite base for excellent accuracy
Vibration Isolation	Self leveling pneumatic isolation system (option: passive or electronically controlled active leveling)
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear (0.01 nm optional), 0.0000001° rotary
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 300 l/min, 10 µm prefiltered; Electrical: 400 V, 16 A, 50/60 Hz; Water: 8-10 °C, 30 l/min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size	1850 * 3500 * 2350 mm (D * W * H)
Standalone Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Z-AXIS
Travel	600 mm	400 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	3,000 mm/min	4,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor
Static Stiffness	420 N/µm vertical	420 N/µm vertical
Media supply	Compact integrated hydrostatic supply unit, low pulsation	

ROTARY AXES	C-AXIS	B-AXIS (OPTION)	MILLING SPINDLE (OPTION)
Type	Workholding Spindle; groove compensated air bearing	Oil hydrostatic axis, 360° continuous	Air bearing
Load Capacity	70 kg at 6.9 bar (radial)	< 300 kg (axial)	< 30 kg (radial)
Axial Stiffness	228 N/µm	370 N/µm	65 N/µm
Radial stiffness	98 N/µm at 6.9 bar	125 N/µm	40 N/µm
Motion Accuracy Axial	< 15 nm	< 50 nm	
Motion Accuracy Radial	< 15 nm	< 80 nm	< 30 nm
Velocity Control	< 10,000 rpm		60,000; 80,000; 90,000 rpm
Position Control	0-3,000 rpm	20 rpm	
Feedback Resolution	0.008 arcsec	0.005 arcsec	
Thermal Control	Integrated cooling	Integrated cooling	Integrated cooling
Interface	NanoGrip	NanoGrip	HSK 25

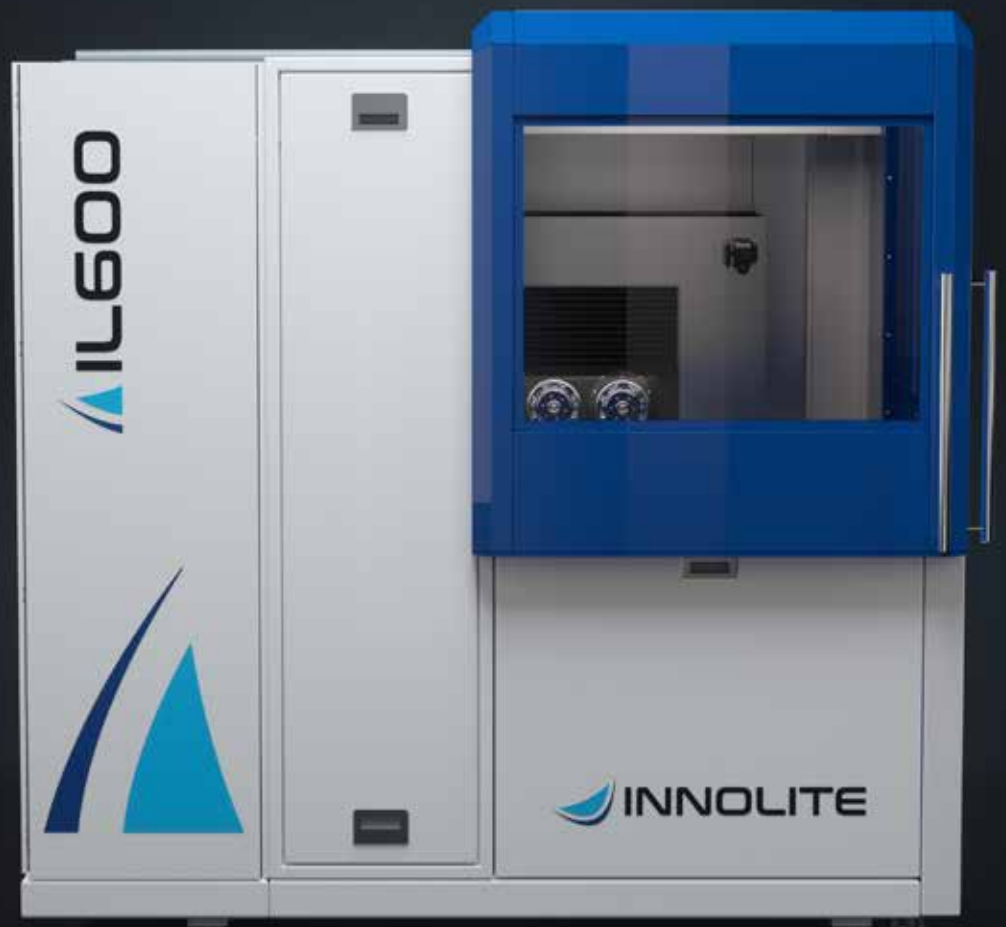
METROLOGY | LVDT (OPTION)		METROLOGY | CONFOCAL PROBE (OPTION)	
2D Surface Line Scan	Air bearing LVDT probe for compensation	Measurement of Optical Surface	Scanning chromatic confocal probe
Working Distance / Range	0.5 mm	Working Distance / Range	6 mm / 0.3 mm
Resolution	< 10 nm	Resolution of Sensor	< 10 nm
Stylus Tip	Ruby, diamond	Data Acquisition	1,000 pts/sec in spiral or orbit scan, full surface

ILSONIC (OPTION)	OVERDRIVE 20/6 (OPTION)
Transversal ultrasonic unit for diamond turning of steel	High dynamic axis for freeform generation, aerostatic bearing
Working Frequency: 100 kHz	Total travel: 20 mm / 6 mm
Max. Depth for Concave Parts: 70 mm	Max. acceleration: 20 G / 40 G
NanoGrip Interface to Machine	Drive: Linear Motor / Voice Coil
55° Insert tool, monocrystalline diamond	Feedback: encoder resolution 0.03125 nm
	CNC Standard Integration DirectDrive3D

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

PART	GENERAL DESCRIPTION
Size	Ø < 540 mm; length < 250 mm; possible by crane
Turning performance	Form accuracy (PV) < 0.1 µm; Surface roughness (Ra) < 1 nm
Overdrive Tilted Plane	Ø < 100 mm; angle 3°; form accuracy (PV) < 0.2 µm
Overdrive Freeform HUD	250 * 200 mm; total stroke 2.1 mm; form accuracy (PV) < 0.5 µm; machining time 3.5 h

IL600 FIVE AXES. PROCESS VARIETY. OPTICS CHARACTERIZATION.



The IL600 is a four- or optionally five-axis ultra-precision machining center for highly productive optics production. The integrated NanoGrip zero-point clamping systems are world leaders in flexibility in diamond machining systems. The IL600 enables the combination of diamond turning and free-form turning, planing and milling as well as the grinding of optical surfaces. In addition to the machining processes, we offer a range of contact and non-contact sensors that can be fully integrated into the machine and the control system for advanced component characterization.

IL600 GENERAL

System Configuration	Ultra precision 4-6 axes (XYZC;B;W) CNC high dynamic machining center
Machine Base	Natural granite base for excellent accuracy
Vibration Isolation	Self leveling pneumatic isolation system (option: passive or electronically controlled active leveling)
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear (0.01 nm optional), 0.0000001° rotary
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 300 l/min, 10 µm prefiltered; Electrical: 400 V, 16 A, 50/60 Hz; Water: 8-10 °C, 30 l/min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size	2400 * 2800 * 2200 mm (D * W * H)
Standalone Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Y-AXIS	Z-AXIS
Travel	600 mm	250 mm	400 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	6,000 mm/min	4,000 mm/min	2,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor	Brushless linear motor
Static Stiffness	420 N/µm vertical	420 N/µm vertical	420 N/µm vertical
Media supply	Compact integrated hydrostatic supply unit, low pulsation		

ROTARY AXES	C-AXIS	B-AXIS (OPTION)	MILLING SPINDLE (OPTION)
Type	Workholding Spindle; groove compensated air bearing	Oil hydrostatic axis, 360° continuous	Air bearing
Load Capacity	70 kg at 6.9 bar (radial)	< 300 kg (axial)	< 30 kg (radial)
Axial Stiffness	228 N/µm	370 N/µm	65 N/µm
Radial stiffness	98 N/µm at 6.9 bar	125 N/µm	40 N/µm
Motion Accuracy Axial	< 15 nm	< 50 nm	
Motion Accuracy Radial	< 15 nm	< 80 nm	< 30 nm
Velocity Control	< 10,000 rpm		60,000; 80,000; 90,000 rpm
Position Control	0-3,000 rpm	20 rpm	
Feedback Resolution	0.008 arcsec	0.005 arcsec	
Thermal Control	Integrated cooling	Integrated cooling	Integrated cooling
Interface	NanoGrip	NanoGrip	HSK 25

METROLOGY | LVDT (OPTION)		METROLOGY | CONFOCAL PROBE (OPTION)	
2D Surface Line Scan	Air bearing LVDT probe for compensation	Measurement of Optical Surface	Scanning chromatic confocal probe
Working Distance / Range	0.5 mm	Working Distance / Range	6 mm / 0.3 mm
Resolution	< 10 nm	Resolution of Sensor	< 10 nm
Stylus Tip	Ruby, diamond	Data Acquisition	1,000 pts/sec in spiral or orbit scan, full surface

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

ILSONIC (OPTION)	OVERDRIVE (OPTION)	A-AXIS
Transversal ultrasonic unit for diamond turning of steel	High dynamic axis for freeform generation, hydrostatic bearing	Air bearing rotory axis for tool positioning
Working Frequency: 100 kHz	Total travel: 50 mm	Torque motor driven
Max. Depth for Concave Parts: 70 mm	Max. acceleration: 10 G	NanoGrip interfacing for tool adapters
NanoGrip Interface to Machine	Drive: Linear Motor	Full CNC interpolation
55° Insert tool, monocrystalline diamond	Feedback: encoder resolution 0.03125 nm	
	CNC Standard Integration DirectDrive3D	

PART	GENERAL DESCRIPTION
Size	Ø < 600 mm; length < 250 mm; possible by crane
Turning performance	Form accuracy (PV) < 0.1 µm; Surface roughness (Ra) < 1 nm
Overdrive Tilted Plane	Ø < 100 mm; angle 3°; form accuracy (PV) < 0.5 µm
Overdrive Freeform HUD	250 * 200 mm; total stroke 2.1 mm; form accuracy (PV) < 0.5 µm; machining time 3.5 h
Tools	Diamond tools, grinding wheels
Machinable parts	(1) Metal mold: nickel-plated carbide, steel, tungsten steel, aluminium, copper, germanium and so on (2) Optical components: ceramics, glass, PMMA plastic and other

IL1200 LARGE. LARGER. VERTICAL.

The IL1200 is a vertical diamond turning platform to machine large scale optical mirrors of diameters up to 1.2 m. The all hydrostatic supported portal structure allows for ulitmate precision in diamond turning. The vertical arrangement of the main spindle allows for stress optimized mounting of mirror structures and precision alignment without influences of gravitational forces. NanoGrip interfaces at the Z-slide ensure the adaptation of different tool holders, other fixtures or metrology sensors to tailer complex machining sequences. Supported by ILCAM software advanced diamond turning, compensation and characterization are feasible in one platform.

IL1200 GENERAL

System Configuration	Ultra precision 4 axes (XYZC) CNC large scale vertical machining center
Machine Base	Natural granite base for excellent accuracy
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 500 l/min, 10 µm prefiltered; Electrical: 400 V, 32 A, 50/60 Hz; Water: 8-10 °C, 20 l/min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size Standalone	3000 * 3600 * 3200 (D * W * H)
Power Cabinet	2500 * 1200 * 2100 mm (D * W * H)
Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Y-AXIS	Z-AXIS
Travel	950 mm	850 mm	400 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	2,000 mm/min	2,000 mm/min	2,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor	Brushless linear motor
Bearing Type	Hydrostatic	Hydrostatic	Hydrostatic
Static Stiffness	420 N/µm vertical	420 N/µm vertical	205 N/µm horizontal (at guideway)

PERIPHERIE

WATER CONDITIONING UNIT	CHIP EVACUATION
4-Channel active control water conditioning unit	Integrated industrial vacuum cleaner
Temperature control < 0.01 °C at outlet	Hose connection to nozzle inside machining room
Required cold water supply 8 °C -10°C @ 20 l/min	M-command controllable
Active temperature plot in HMI	

IN LINE METROLOGY

CHROMATIC CONFOCAL SENSOR	TACTILE SENSOR	LVDT	CAMERA
Scanning chromatic confocal probe	X, Y, Z tactile probe system with strain gauge technology	2D Surface Line Scan	High resolution CCD camera
Working Distance / Range : 6 mm / 0.3 mm	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange	ir bearing LVDT probe for compensation	Telecentric objective (standard)
Resolution of Sensor : < 10 nm	Tactile Force: XY plane: 0.02 N; Z: 0.07 N	Range : 0.5 mm	Microscope objectives (on demand)
Data Acquisition : 1,000 pts/sec in spiral	Unidirectional Repeatability: Trigger level 1: 0.40 µm	Resolution : < 10 nm	Integrated illumination
or orbit scan, full surface	Form Measurement Deviation: Trigger level 1: ± 0.80 µm	Stylus Tip : Ruby, diamond	Field of view: 500 µm x 500 µm

PART & PERFORMANCE	WATER CONDITIONING UNIT
Size	ø < 1200 mm, height < 350 mm
Weight	up to 400 kg @ 9 bar
Turning performance	Form accuracy (PV) < 0.5 µm; Surface roughness (Ra) < 2 nm

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

IL1500 LARGE. LARGER. VERTICAL.

The IL1500 is a vertical diamond turning platform to machine large scale optical mirrors of diameters up to 1.5 m. The all hydrostatic supported portal structure allows for ulitmate precision in diamond turning. The vertical arrangement of the main spindle allows for stress optimized mounting of mirror structures and precision alignment without influences of gravitational forces. NanoGrip interfaces at the Z-slide ensure the adaptation of different tool holders, other fixtures or metrology sensors to tailer complex machining sequences. Supported by ILCAM software advanced diamond turning, compensation and characterization are feasible in one platform.

IL1500 GENERAL

System Configuration	Ultra precision 4 axes (XYZC) CNC large scale machining center
Machine Base	Natural granite base for excellent accuracy
Vibration Isolation	Self leveling pneumatic isolation system
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 500 l/min, 10 µm prefiltered; Electrical: 400 V, 32 A, 50/60 Hz; Water: 8-10°C, 30 l/min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size Standalone	3100 * 4100 * 3600 (D * W* H)
Power Cabinet	2500 * 1200 * 2100 mm (D * W * H)
Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Y-AXIS	Z-AXIS
Travel	1150 mm	1150 mm	400 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	2,000 mm/min	2,000 mm/min	1,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor	Brushless linear motor
Static Stiffness	420 N/µm vertical	420 N/µm vertical	420 N/µm vertical
Media Supply	Compact integrated hydrostatic supply unit, low pulsation		

ROTARY AXES	C-AXIS (IN X)	MILLING SPINDLE (OPTION)
Type	Workholding Spindle; groove compensated air bearing	Air bearing
Load Capacity	1500 kg at 9 bar (radial)	< 30 kg (radial)
Axial Stiffness	1150 N/µm	65 N/µm
Radial stiffness	230 N/µm at 7 bar	40 N/µm
Motion Accuracy Axial	< 15 nm	
Motion Accuracy Radial	< 15 nm	< 30 nm
Velocity Control	< 300 rpm	60,000; 80,000; 90,000 rpm
Position Control		
Feedback Resolution	0.008 arcsec	
Thermal Control	Integrated cooling	Integrated cooling
Interface	NanoGrip (optional)	HSK 25

METROLOGY | LVDT (OPTION)		METROLOGY | CONFOCAL PROBE (OPTION)	
2D Surface Line Scan	Air bearing LVDT probe for compensation	Measurement of Optical Surface	Scanning chromatic confocal probe
Working Distance / Range	0.5 mm	Working Distance / Range	6 mm / 0.3 mm
Resolution	< 10 nm	Resolution of Sensor	< 10 nm
Stylus Tip	Ruby, diamond	Data Acquisition	1,000 pts/sec in spiral or orbit scan, full surface

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

PART	GENERAL DESCRIPTION
Size	Ø < 1,500 mm; possible by crane
Turning performance	Form accuracy (PV) < 0.5 µm; Surface roughness (Ra) < 3 nm

IL CENTRIC 300 OPTICS ALIGNMENT. OPTICS PRODUCTION. PRECISE MECHANICS.

The ILCENTRIC300 is the leading ultra-precision machine platform for high-performance alignment of mounted lenses with diameters of up to 250 mm. Various integrated optical and tactile sensors enable the centering of all relevant modern optics. The ILCENTRIC does not use a conventional center chuck, but a unique dynamic turning process to correct the alignment of the optical axes from lens to frame.

As a result, the machine can be used not only for alignment turning, but also for the diamond turning process and the high-precision manufacturing of mechanical components. The machine utilization can thus be individually adjusted between alignment turning and ultra-precise manufacturing in order to minimize depreciation periods.

ILCENTRIC300 GENERAL

System Configuration	Ultra precision 3-5 axes (XZC;B;W) CNC high dynamic machining center
Machine Base	Natural granite base for excellent accuracy
Vibration Isolation	Self leveling pneumatic isolation system (option: passive or electronically controlled active leveling)
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear (0.01 nm optional), 0.0000001° rotary
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 300 l/min, 10 µm prefiltered; Electrical: 400 V, 16 A, 50/60 Hz; Water: 8-10 °C, 30 l/min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size	2000 * 1900 * 2100 mm (D * W * H)
Air conditioner Size	510 * 1100 * 740 mm (D * W * H)
Standalone Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Z-AXIS
Travel	300 mm	300 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	3,000 mm/min	6,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor
Static Stiffness	420 N/µm vertical	420 N/µm vertical
Media supply	Compact integrated hydrostatic supply unit, low pulsation	

ROTARY AXES	C-AXIS
Type	Workholding Spindle; groove compensated air bearing
Load Capacity	70 kg at 6.9 bar (radial)
Axial Stiffness	228 N/µm
Radial stiffness	98 N/µm at 6.9 bar
Motion Accuracy Axial	< 15 nm
Motion Accuracy Radial	< 15 nm
Velocity Control	< 10,000 rpm
Position Control	0-3,000 rpm
Feedback Resolution	0.008 arcsec
Thermal Control	Integrated cooling
Interface	NanoGrip

METROLOGY | LVDT (OPTION)		METROLOGY | CONFOCAL PROBE (OPTION)	
2D Surface Line Scan	Air bearing LVDT probe for compensation	Measurement of Optical Surface	Scanning chromatic confocal probe
Working Distance / Range	0.5 mm	Working Distance / Range	6 mm / 0.3 mm
Resolution	< 10 nm	Resolution of Sensor	< 10 nm
Stylus Tip	Ruby, diamond	Data Acquisition	1,000 pts/sec in spiral or orbit scan, full surface

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm,ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

ILSONIC (OPTION)	OVERDRIVE (OPTION)	CIRCULATING AIR SHOWER (OPTION)
Transversal ultrasonic unit for diamond turning of steel	High dynamic axis for freeform generation, hydrostatic bearing	Air conditioning unit with filtration system
Working Frequency: 100 kHz	Total travel: 20 mm	Air Flow Rate: 400 l/min
Max. Depth for Concave Parts: 70 mm	Max. acceleration: 20 G	Temperature Constancy < 0.1 °C
NanoGrip Interface to Machine	Drive: Linear Motor	Required Room Temperature < 3 °C
55° Insert tool, monocrystalline diamond	Feedback: encoder resolution 0.03125 nm	Machine external setup, integrated control
	CNC Standard Integration DirectDrive3D	

AUTOCOLLIMATOR	OPTOALIGNMENT LAS	POWERMETER
Spheres & planos	Spheres & planos	
Achromats, triplets	Achromats, triplets	
	Infrared optics	
		Laser sources
6x objective exchanger	fixed objective	CMOS Beam Profiler
140, 200 & 300 mm focal length	520 nm laser light source visible	25 x 25 mm field of view
Led lightsource 520 & 850 nm	4,05µm laser light source IR	4.2 Mpixel

PART	GENERAL DESCRIPTION
Size	Ø < 300 mm; length < 250 mm
Turning performance	Form accuracy (PV) < 0.1 µm; Surface roughness (Ra) < 1 nm
Overdrive Tilted Plane	Ø < 100 mm; angle 3°; form accuracy (PV) < 0.2 µm
Overdrive Freeform HUD	250 * 200 mm; total stroke 2.1 mm; form accuracy (PV) < 0.5 µm; machining time 3.5 h

IL CENTRIC 500 OPTICS ALIGNMENT. PROCESS COMBINATION. AUTOMATION.

Based on the experience with the ILCENTRIC300, the ILCENTRIC500 has been developed for aligning large lenses with diameters of up to 400 mm. Furthermore, the machine offers space to integrate additional, permanently equipped measuring technology or processes such as the engraving of reference marks, the milling of reference grooves or automated assembly using robots. The ILCENTRIC does not use a conventional center chuck, but a unique dynamic turning process to correct the alignment of the optical axes from lens to frame. As a result, the machine can be used not only for alignment turning, but also for the diamond turning process and the high-precision manufacturing of mechanical components. The machine utilization can thus be individually adjusted between alignment turning and ultra-precise manufacturing in order to minimize depreciation periods.

IL500 GENERAL	
System Configuration	Ultra precision 3-5 axes (XZC;B;W) CNC high dynamic machining center
Machine Base	Natural granite base for excellent accuracy
Vibration Isolation	Self leveling pneumatic isolation system (option: passive or electronically controlled active leveling)
Control System	Beckhoff TwinCAT 3 CNC high performance machine controller; Intel® Core™ i5 CPU, 6 Cores; Microsoft Windows 10 IoT Enterprise; 23" color flat panel touch screen display and 24" color flat panel display; EtherCAT bus communication technology; Digital Servo drives with 100 kHz current & position control loop frequency
Programming Resolution	1 nm linear (0.01 nm optional), 0.0000001° rotary
Set Points [pts/sec]	Up to 2,000 in CNC mode; 10,000 in DirectDrive3D
File Transfer	USB, Ethernet
Requirements	Air: 7-10 bar, 300 l/min, 10 µm prefiltered; Electrical: 400 V, 16 A, 50/60 Hz; Water: 8-10 °C, 30 l/min; Connectivity: Ethernet
Air shower (integ.)	Air conditioning unit with filtration, flow rate 600 l/min, temp. Constancy < 0.05 °C, control integration
Machine Size	1850 * 3500 * 2350 mm (D * W * H)
Standalone Panel Size	610 * 610 mm (D * W)

LINEAR AXIS	X-AXIS	Z-AXIS
Travel	600 mm	400 mm
Feedback Type	Noncontact linear encoder	Noncontact linear encoder
Resolution	0.03125 nm	0.03125 nm
Straightness	< +/- 0.2 µm	< +/- 0.2 µm
Pitch, Roll, Yaw	< +/- 2 arcsec for all	< +/- 2 arcsec for all
Max. Speed	3,000 mm/min	4,000 mm/min
Drive System	Brushless linear motor	Brushless linear motor
Static Stiffness	420 N/µm vertical	420 N/µm vertical
Media supply	Compact integrated hydrostatic supply unit, low pulsation	

ROTARY AXES	C-AXIS	B-AXIS (OPTION)	MILLING SPINDLE (OPTION)
Type	Workholding Spindle; groove compensated air bearing	Oil hydrostatic axis, 360° continuous	Air bearing
Load Capacity	70 kg at 6.9 bar (radial)	< 300 kg (axial)	< 30 kg (radial)
Axial Stiffness	228 N/µm	370 N/µm	65 N/µm
Radial stiffness	98 N/µm at 6.9 bar	125 N/µm	40 N/µm
Motion Accuracy Axial	< 15 nm	< 50 nm	
Motion Accuracy Radial	< 15 nm	< 80 nm	< 30 nm
Velocity Control	< 10,000 rpm		60,000; 80,000; 90,000 rpm
Position Control	0-3,000 rpm	20 rpm	
Feedback Resolution	0.008 arcsec	0.005 arcsec	
Thermal Control	Integrated cooling	Integrated cooling	Integrated cooling
Interface	NanoGrip	NanoGrip	HSK 25

METROLOGY | LVDT (OPTION)		METROLOGY | CONFOCAL PROBE (OPTION)	
2D Surface Line Scan	Air bearing LVDT probe for compensation	Measurement of Optical Surface	Scanning chromatic confocal probe
Working Distance / Range	0.5 mm	Working Distance / Range	6 mm / 0.3 mm
Resolution	< 10 nm	Resolution of Sensor	< 10 nm
Stylus Tip	Ruby, diamond	Data Acquisition	1,000 pts/sec in spiral or orbit scan, full surface

AUTOCOLLIMATOR	OPTOALIGNMENT LAS	POWERMETER
Spheres & planos	Spheres & planos	
Achromats, triplets	Achromats, triplets	
	Infrared optics	
		Laser sources
6x objective exchanger	fixed objective	CMOS Beam Profiler
140, 200 & 300 mm focal length	520 nm laser light source visible	25 x 25 mm field of view
Led lightsource 520 & 850 nm	4,05 µm laser light source IR	4.2 Mpixel

AUTOMATION | NANOGRIP INTERFACE	AUTOMATION | 3D TACTILE PROBE (OPTION)
Ultra-precise clamping system for workpiece & tool	X, Y, Z tactile probe system with strain gauge technology
Clamping mechanism: Spring loaded mechanical clamping, pneumatic unclamping	Stylus: Length up to 100 mm, ruby and diamond tips, fast exchange
Repeatability / Accuracy: < 0.5 µm radial & axial	Tactile Force: XY plane: 0.02 N; Z: 0.07 N
Clamping force: > 20,000 N for excellent stiffness and accuracy	Unidirectional Repeatability: Trigger level 1: 0.40 µm
Interfaces for workpiece: Vacuum chuck, three jaw chuck, individual mounting or blocking	Form Measurement Deviation: Trigger level 1: ± 0.80 µm

ILSONIC (OPTION)	OVERDRIVE 20/6 (OPTION)
Transversal ultrasonic unit for diamond turning of steel	High dynamic axis for freeform generation, aerostatic bearing
Working Frequency: 100 kHz	Total travel: 50 mm
Max. Depth for Concave Parts: 70 mm	Max. acceleration: 10 G
NanoGrip Interface to Machine	Drive: Linear Motor / Voice Coil
55° Insert tool, monocrystalline diamond	Feedback: encoder resolution 0.03125 nm
	CNC Standard Integration DirectDrive3D

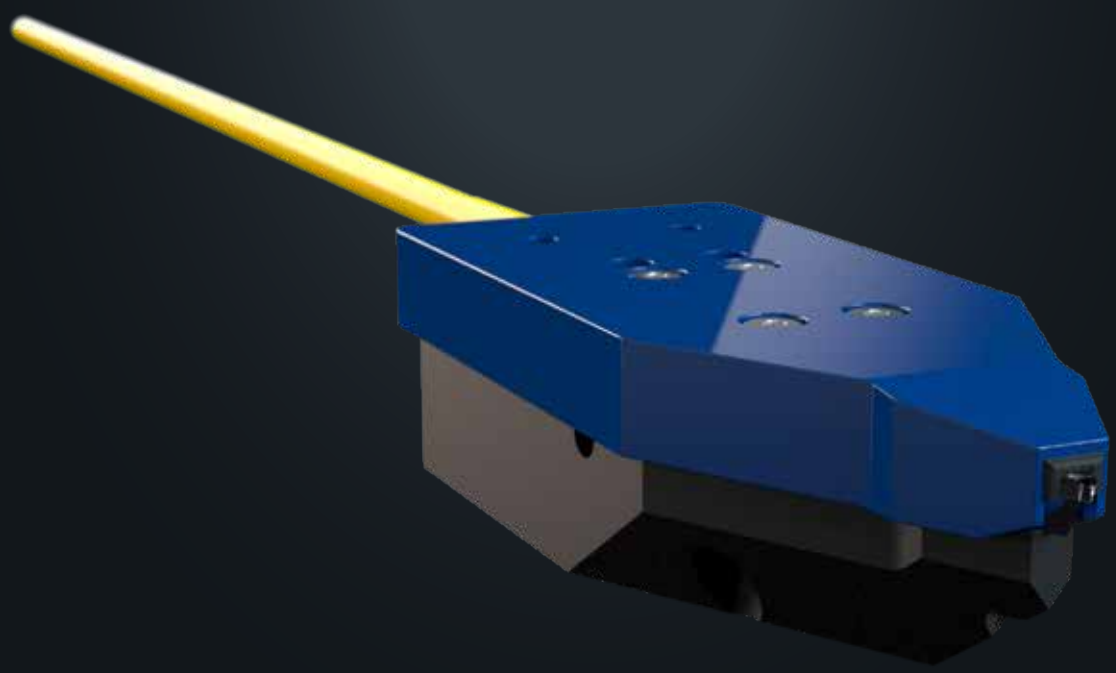
PART	GENERAL DESCRIPTION
Size	Ø < 540 mm; length < 250 mm; possible by crane
Turning performance	Form accuracy (PV) < 0.1 µm; Surface roughness (Ra) < 1 nm
Overdrive Tilted Plane	Ø < 100 mm; angle 3°; form accuracy (PV) < 0.2 µm
Overdrive Freeform HUD	250 * 200 mm; total stroke 2.1 mm; form accuracy (PV) < 0.5 µm; machining time 3.5 h

ILSONIC MONOLITHIC

The patented **ILSONIC MONOLITHIC** is the world´s leading ultrasonic tooling system operating at up to 100 kHz. With the use of ultrasonic assisted ultraprecise diamond cutting, optical surface fi nishes can be achieved in hardened steel for high performance mold inserts or even glass substrates. For the past eight years Innolite has been using the ILSONIC Technology internally to diamond cut optical surfaces in steel for LED headlight mold inserts as a leading supplier in German automotive production. The new ILSONIC MONOLITHIC has been developed based on this outstanding long term industrial experience for highest effi ciency and longest lifetime of the product.

The ultrasonic tooling system ILSONIC MONOLITHIC consists of a piezo drive and a specially designed and patented sonotrode to operate in resonance frequency. As a unique feature, the entire system design is realized as a monolithic unit without bolted interfaces that are eff ected by the high frequency vibration over time. A diamond tool, attached to the front tip of the sonotrode oscillates at resonance frequency on an elliptical tool path allowing for extended applications in diamond cutting. With its unique monolithic design the ILSONIC signifi cantly diff ers from the competitor's products in terms of long term stability and lifetime.

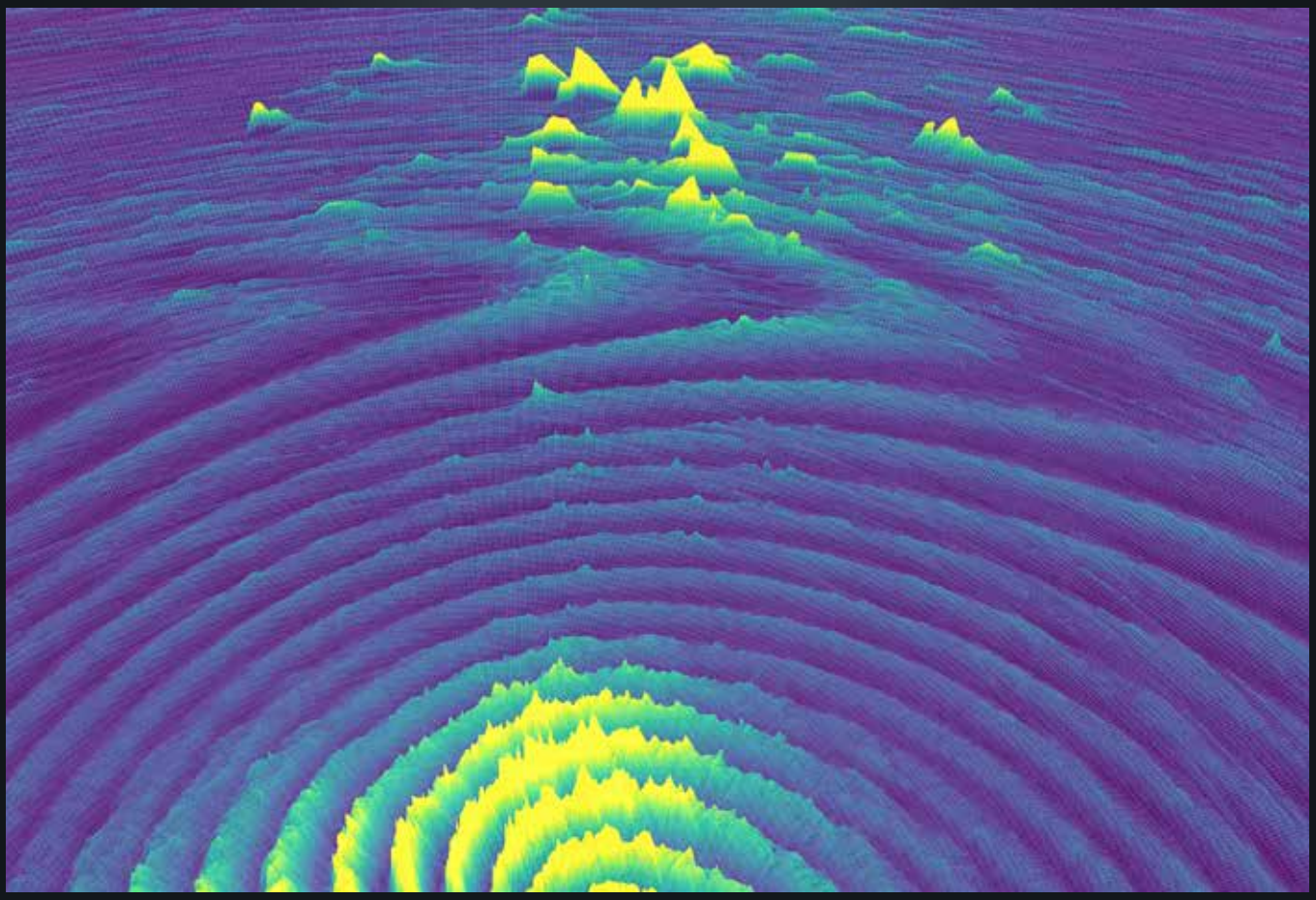
ILSONIC ILPAC



Photon assisted cutting (PAC) by laser is an approach to improve or even enable diamond turning of brittle materials such as infrared optics or tungsten carbide molds. Innolite has developed a new tooling system combining the diamond tool with glass fibre for laser light guidance.

The **ILPAC** tooling system is characterized by its highly integrated design ensuring for rigidity and low weight design. It allows for advanced free-form machining and multi tool integration for roughing and finishing. Along with the Innolite laser safe machines, you can use the hybrid process in your standard production at full compliance with safety regulations.

SOFTWARE ILANALYZE



The manufacturing accuracy of a complex surface depends on machine performance as well as the integrity of the data set that serves as the basis for tool path planning.

CAD files or files translated from optics-design applications may show numerical errors and discontinuities in the submicron range, which are noticeable in diamond machining.

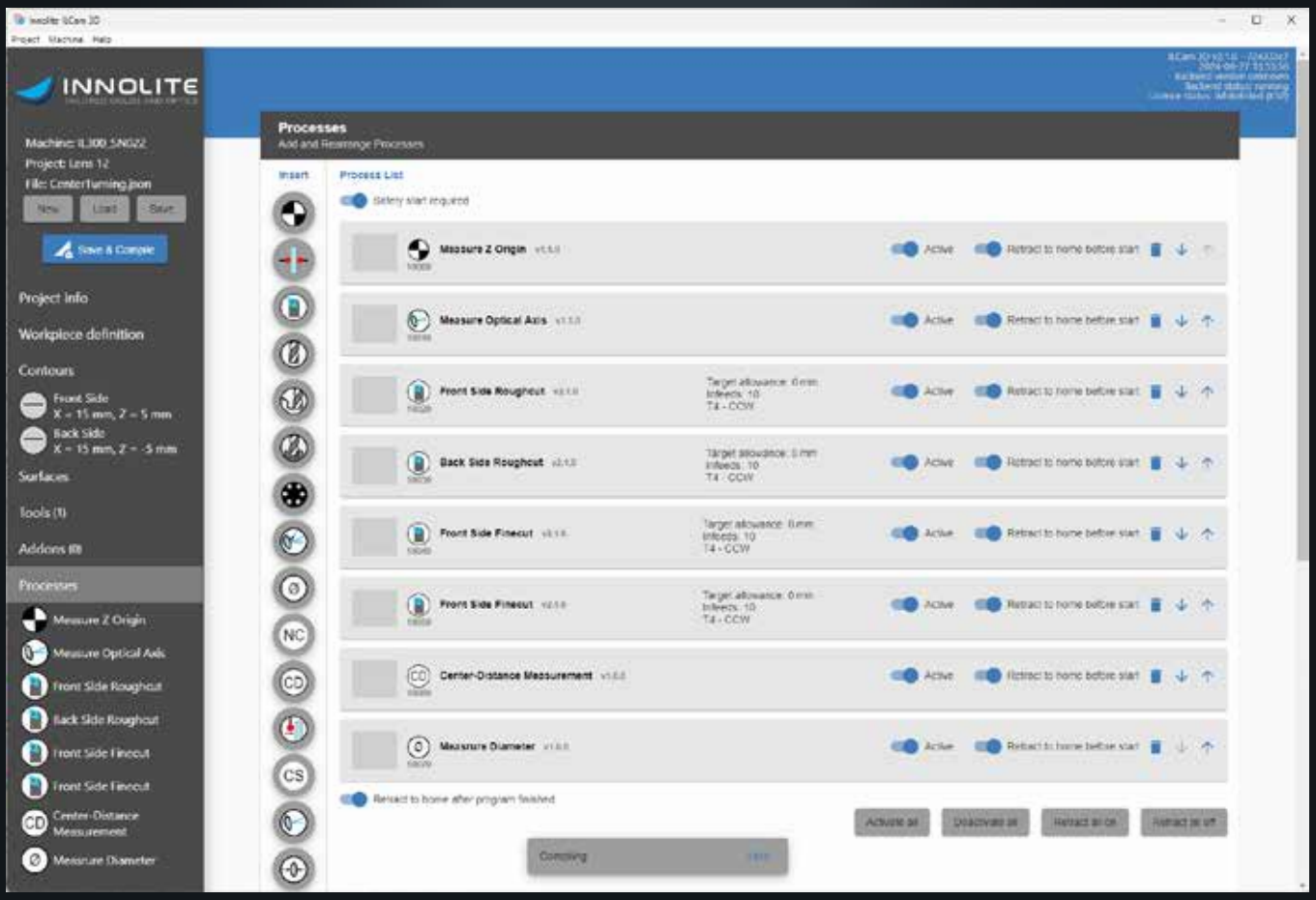
ILAnalyze is a stand-alone software tool that performs a dedicated continuity analysis, investigating data quality before any machining takes place.

The application loads 3d surface data to run differential geometry analysis operations such as slope, curvature, or waviness detection.

Visualize 2d cross sections to better understand your surface data quality in detail and apply smoothing operations to improve corrupted data sets.

A purpose-built 3d visualization tool is the backbone of the application, enabling a dive into the properties of the surface about to be manufactured.

SOFTWARE ILCAM



ILCAM3D is the basic software platform for all IL series ultra-precision machine tools. It supports any tool path generation for turning, free-form or micro-structure turning jobs. The software has been developed and growing over the past 10 years summarizing all of our experience and background at Innolite. It will never be ready, it constantly improves and expands for future challenging requirements driven by our customer needs.

Based on ILCAM3D you can program simple geometries such as aspheres or lens arrays or load complicated free-form surfaces for tool path planning and programming. Specify tools cutting strategies and parameters, combine multiple cuts for pre-machining and finishing with different parameters or program measurement tasks for in-line sensors on IL series machines. The user-friendly software with graphical support will generate standard G-Code to be executed at the machine. Such programs can be edited and extended by those operators that are firm with the syntax of G-code.

The DirectDrive3D software package is an add-on to ILCAM3D and will add on to the standard functionality of CNC code interpolation. The software module calculates fully synchronized single axis motion profiles based on the defined tool path including dynamic parameters such as speeds, accelerations and jerk at a world leading fixed set point frequency of 10,000 points per second.

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