

# Freeform® L

Whether you need to manufacture a freeform part today or want the flexibility for future market requirements, the **Freeform® L** is precisely the machine you need.

Precitech has added an innovative vertical axis to our field proven large frame platform, increasing flexibility and precision. With the Freeform L, customers can diamond turn, micro-mill, micro-grind, and groove non-rotationally symmetric surfaces. Adding this third linear axis gives users the flexibility to produce freeform surfaces which may not be achievable using 2 linear axis machining.

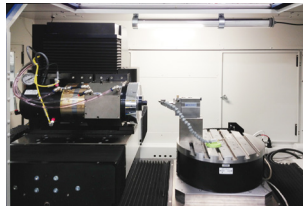
Since 1962 we have delivered complete ultra precision solutions and maintain an installed base of over 1,500 systems worldwide. We continue to define the state-of-the-art, enhancing accuracy, productivity, and ease of use.

**Precitech is ultra precision machining solutions.**

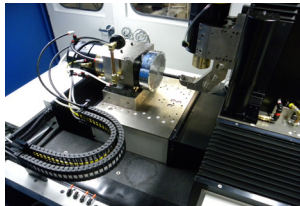
Shown in a standard lathe enclosure. Also available in a full temperature controlled room for maximum precision.



- ▶ **Industry leading swing and load capacity**
- ▶ **Flexibility to produce freeform geometries with 3 linear and up to 2 rotary CNC axes**
- ▶ **5 Axis freedom with 3 axis performance**  
*Y axis and spindle designed for maximum thermal stability*
- ▶ **Thermally controlled enclosure options**  
*insure accuracy during long cutting-time parts*
- ▶ **Reduced sensitivity to vibration**  
*enabled by its integral TMC MaxDamp® isolation system*
- ▶ **Capability to produce large and small parts**  
*auxiliary spindle mount to the X axis*

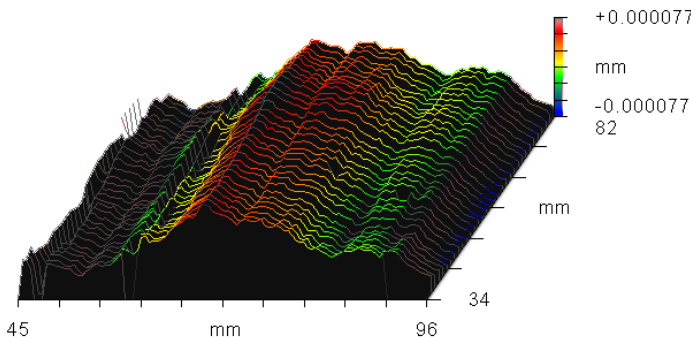


Turning Configuration (T)



Milling Configuration (M)  
(B axis is not used in the M configuration. 300 mm maximum swing capacity)

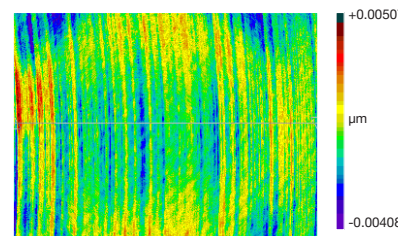
**60 hour stability test using raster flycutting resulting in a 36 nm rms form error (50 mm x 50 mm Nickel Phosphorus)**



Removed: PST LST	PV	0.154	µm
	rms	0.036	µm

### Key Specifications

Turning performance	Surface roughness < 1.5 nm Sa Form accuracy < 0.125 µm P-V (tested and measured on one surface upon request)
Milling performance	Surface roughness < 10 nm Ra (< 3 nm is achievable with optimum material and cutting conditions) Form accuracy < 0.2 µm P-V
Swing capacity	650 mm dia. maximum 415 mm dia. over B axis with standard tooling (can be expanded upon request) 700 mm when equipped with temperature controlled room



**YZ turning test resulting in a 0.83 nm Ra surface finish (Nickel Phosphorus)**

PV	9.156	nm	Size X	0.7	mm
rms	1.054	nm	Size Y	0.5	mm
Ra	0.829	nm			

Machine Base and Control		Description	
Machine base	Sealed natural granite base provides exceptional long term machine tool stability		
Machine type	Ultra precision five axis ( <i>Freeform TL</i> ) or four axis ( <i>Freeform ML</i> ) CNC contouring machine		
Vibration isolation	Self leveling dual chamber pneumatic isolation system (Optional PEPS® II-VX active vibration cancellation available)		
Control system	UPx™ machine tool control operating system with UPx Data Store and Windows 7 sub systems		
Operating system	QNX real time operating system with 64 bit floating point decimal precision		
Programming resolution	0.01nm linear / 0.0000001° rotary		
File transfers	USB, CD-ROM, Ethernet		
Turning performance	Surface Finish < 1.5 nm Sa, Form Accuracy < 0.125 µm P-V tested and measured on one surface upon request (All measurements according to ISO Standard 4287)		
Milling performance	Milling surface roughness under 10 nm Ra   Milling form accuracy < 0.2 µm P-V (< 3 nm is achievable with optimum material and cutting conditions)		
Linear Hydrostatic Slideways		Description	
Type	Hydrostatic bearing slideways with symmetrical linear motor placement and liquid cooling		
Travel	X axis: 350 mm (13.8 in.) Vertical Y axis: 150 mm (5.9 in.) Z axis: 300 mm (11.8 in.)		
Maximum feedrate	3000 mm/minute (118 in./minute)		
Drive system	Linear motors used on all three linear axes		
Position feedback resolution	0.008 nm for all three linear axes		
Straightness horizontal / vertical	X axis: 0.3 µm (12 µin.) over full travel / 0.75 µm (30 µin.) over full travel Y axis: 0.5 µm (20 µin.) over full travel both directions, 0.3 µm over the central 100 mm Z axis: 0.3 µm (12 µin.) over full travel / 0.75 µm (30 µin.) over full travel		
X,Z Pitch / Roll motion	2.0 arc-sec		
Y Pitch / Yaw motion	2.0 arc-sec		
X, Z Vertical / Horizontal stiffness	438 N/µm (2,500,000 lbs per in.) both directions		
Y axis stiffness in the X and Z direction	263 N/µm (1,500,000 lbs per in.) both directions		
Y axis working load capacity	91 kg (200 lbs)		
Hydrostatic oil supply system	Hydro-7 Smart Servo Control, low pulsation pump, optional thermal control		
Workholding Air Bearing Spindle		High Performance HS150 Spindle (3 year warranty)	
Spindle air bearing type	Slot type thrust bearing		
Materials	Steel shaft / Bronze journal		
Standard swing capacity	650 mm max.   415 mm dia. over the B axis   700 mm when equipped with temperature controlled room		
Ultimate Load Capacity (@ spindle nose)	136 kg (300 lbs.) @ 100 PSI / 204 kg (450 lbs) @ 150 PSI (load capacity with Y axis locked down)		
Axial stiffness	230 N/µm (1,314,000 lbs/in.)		
Radial stiffness	130 N/µm (743,600 lbs/in.)		
Motion accuracy	Axial/Radial ≤ 15 nm (0.6 µin.)		
Thermal control	Liquid cooled chiller +/- 0.1C Accuracy		
C-axis feedback resolution	0.010 arc-sec 16,200 line encoder (0.018 arc-sec 9,000 line encoder available on request)		
C-axis positioning accuracy	+/- 1 arc-sec		
C-axis max speed	2,000 RPM (4,000 RPM with 9,000 line encoder)		
Workholding spindle max speed	10,000 RPM		
Rotary B-axis		HydroRound II Rotary B-axis with Hydrolock	
Type	Patented self compensated oil hydrostatic bearing, Bi-conic, integral brushless DC motor		
Load capacity	454 kg (1000 lbs)		
Tabletop size	381 mm (15 in.) diameter		
Maximum speed	3,600° per minute		
Hydrolock Holding Torque	> 108 N-m / 80 ft-lbs		
Feedback resolution	0.003 arc-sec		
Positioning accuracy	± 0.1 arc-sec		
Radial error motion	0.10 µm (4.0 µin.) @ tool height (6.9 in. above table top), can be improved with optional error mapping		
Axial error motion	0.10 µm (4 µin.)		
Coning error	1.0 nm/mm (1.0 µin./in.)		
Radial stiffness	525 N/µm (3,000,000 lbs/in)		
Axial stiffness	875 N/µm (5,000,000 lbs/in)		
Moment stiffness	17 N-m/µrad (150 in.-lbs/µrad)		
Optional Milling / Grinding Spindles		SP75FF Spindle	Levicron High Speed Milling Spindle
Air supply pressure	690 kPa (100 PSI)	610 kPa (88 PSI)	
Air consumption	50 lpm (1.7 SCFM)	70 lpm (2.5 SCFM)	
Radial load capacity	32 kg (70 lbs) ultimate load capacity	29 kg (65 lbs) ultimate load capacity	
Axial stiffness	70 N/µm (400,000 lbs/in.)	50 N/µm (285,000 lbs/in.)	
Radial stiffness	22 N/µm (125,000 lbs/in.)	35 N/µm (200,000 lbs/in.)	
Axial error motion	Under 0.05 µm (2 µin.)	< 30 nm asynchronous	
Radial Error motion	Under 0.05 µm (2 µin.)	< 30 nm asynchronous	
Maximum speed	15,000 RPM	80,000 RPM (stiffness increases 50% with 60k RPM model)	
Facility Requirements		Freeform® L	
Power	208 or 230 VAC - 1 phase - 50/60 Hz - 4.5 KVA		
Compressed air supply	Typical: 14 scfm at 100 psig, filtered to 50 µm and dry to 10° C dew point		
Machine size and weight	216 cm x 140 cm x 203 cm (85 in. x 55.5 in. x 80 in.) 3400 kg/7500 lbs. (Not including control pendant or auxiliary equipment)		