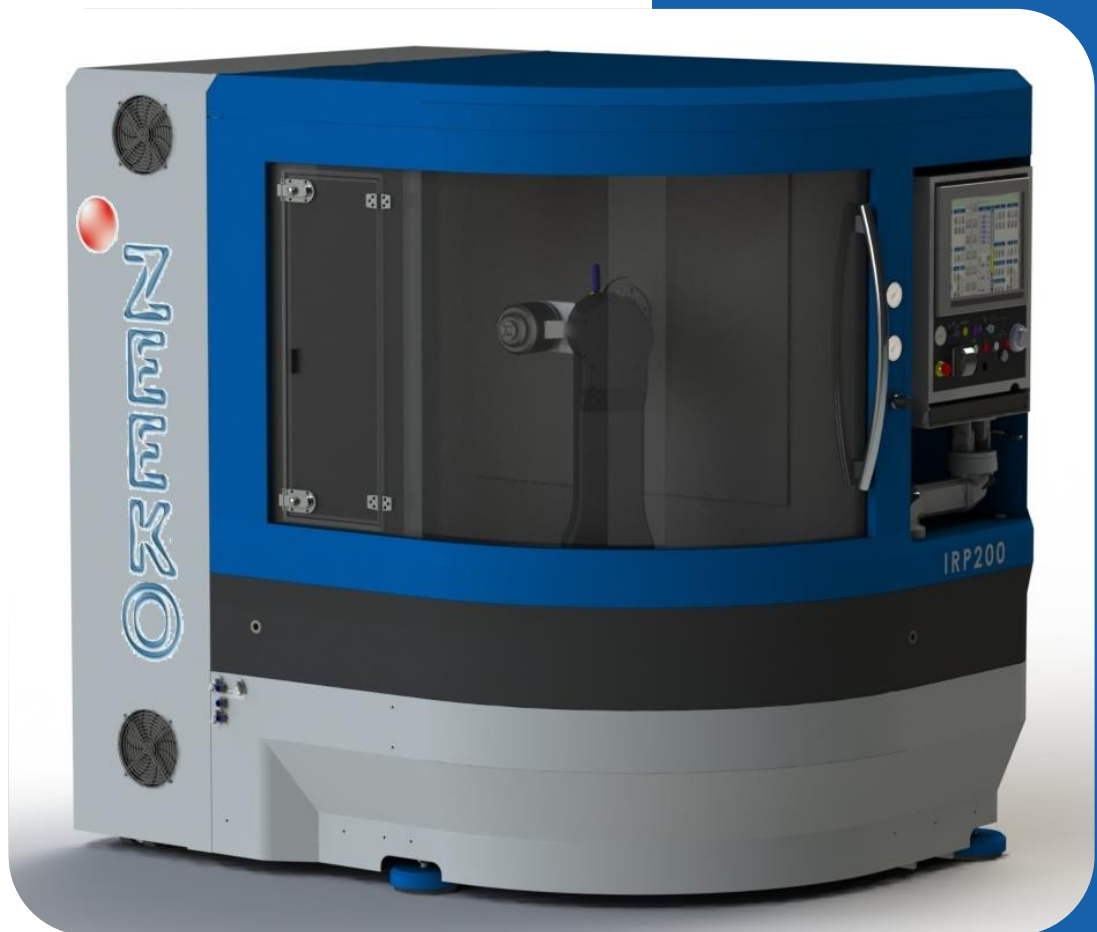




IRP200 MkII 7Axis Linear Motor

Product Specification - Version 1, Release 4



Zeeko

Rev. 06018

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1 Machine Description

The IRP200 is a 7 axis CNC optical polishing/form generating machine capable of producing ultra-precise surfaces on a wide range of materials and surface forms. The machine axes can be used for traditional spiral, raster, and free-form polishing.

- ❖ Mass = 3000 Kg
- ❖ Dimensions = 1500 x 2000 x 2000 (W x D x H mm)

The machine frame is a welded steel structure incorporating the following features:

- ❖ 3 point floor mounting
- ❖ Integrated electrical and pneumatics enclosures
- ❖ Integrated Slurry Management System
- ❖ Integrated chiller unit for slurry
- ❖ 3-point mounting for polymer-granite base
- ❖ Slurry management unit below base
- ❖ Peristaltic System attached (optional)

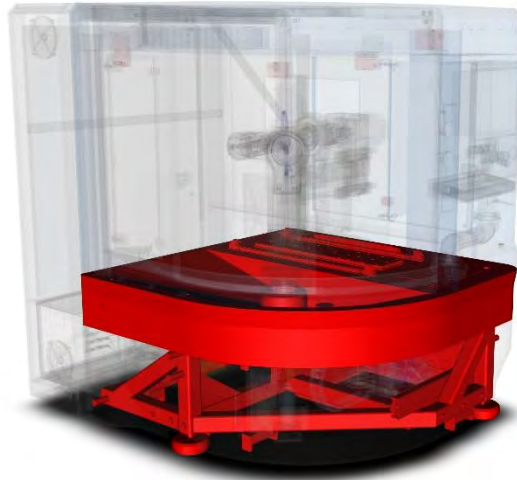
2 Arrangement of the Axes

The arrangement and definition of the 7 CNC axes is as follows:

- ❖ X is a linear axis which mounts horizontally to the polymer-granite base. The X axis carriage is a precision machined stainless steel structure.
- ❖ Y is a linear axis, precision machined stainless steel structure, mounted vertically to the X axis carriage and aligned perpendicular to the X axis.
- ❖ Z is a linear axis, precision machined stainless steel structure, mounted horizontally to the Y axis and is aligned perpendicular to both the X and Y axes.
- ❖ C is a rotational axis that holds the work piece. It is mounted in line with the Z axis.
- ❖ A, B and H are rotational axes configured such that the polishing head (H axis) rotates through a point in space call the Virtual Pivot (VP). This three axes assembly mounts to the Polymer-granite base.

3 Polymer Granite Machine Base

Figure 1: Polymer Granite Base & Welded Steel Frame



The machine base is a precision cast and machined polymer-granite composite structure that provides excellent thermal stability and vibration damping characteristics. This key machine element incorporates the following features:

- ❖ Moulded-in stainless steel inserts for mounting and alignment of the X and A axes and for machine handling and transportation.
- ❖ Threaded stainless steel inserts for mounting the polishing enclosure.
- ❖ Moulded-in feeds for electrical supply and control cables, compressed air, and slurry supply and return.
- ❖ Moulded steel insert for mounting of peripheral hardware (e.g. Measuring Equipment)

4 Linear Axes

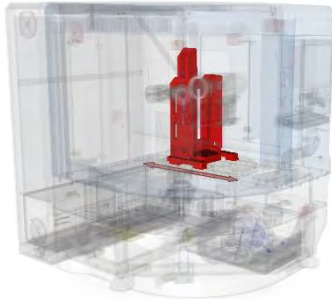


Figure 2: X Axis

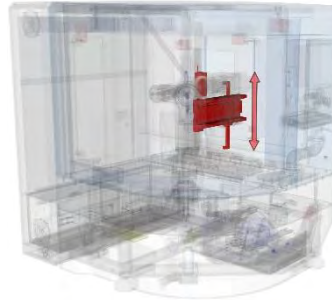


Figure 3: Y Axis

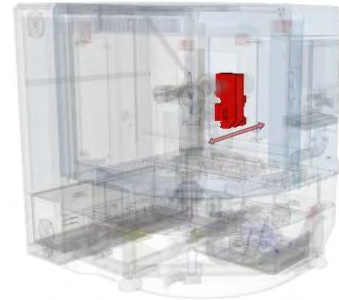


Figure 4: Z Axis

Each axis is mounted on a pair of precision linear motion rails and driven via linear motor. The Y-Axis linear motor system utilizes a servo driven precision ballscrew and spring combination as a counterbalance. Position feedback is provided by the use of absolute linear encoders.

- ❖ Slide type: Precision linear motion
- ❖ Travel (X Axis): rails $\pm 160\text{mm}$
- ❖ Travel (Y Axis) $\pm 160\text{mm}$
- ❖ Travel (Z Axis) 140mm
- ❖ Drive system: Fanuc Linear Motor
- ❖ Positioning feed-back: Absolute linear encoder
- ❖ Max velocity: 3000mm/min

5 Rotary Axes & Spindles

The A,B & H axes provide the primary tool motions and are often referred to as the Virtual Pivot (VP). The VP is mounted directly to the polymer-granite base.

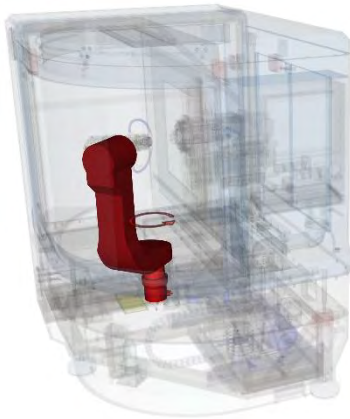


Figure 5: A Axis

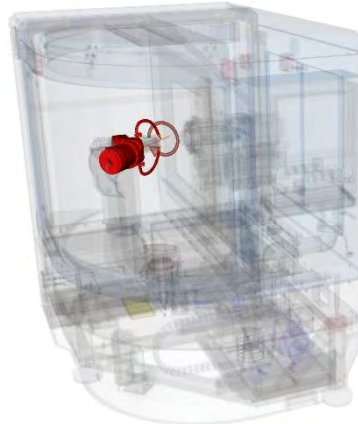


Figure 6: B Axis

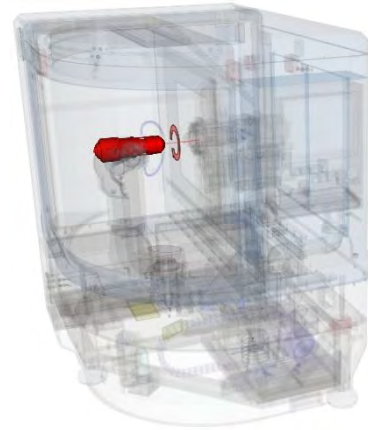


Figure 7: H Axis

The A-axis is mounted to the base via an AC servo drive Harmonic Drive unit with enhanced radial stiffness. Referencing of the position is via a non-contact referencing element. Referencing is only required following power up of the machine.

- ❖ Rotational Range: -50° to $+115^{\circ}$
- ❖ Max Rotational Velocity: 25 rpm

The B axis is mounted to the A axis via AC servo driven Harmonic Drive unit. Referencing of the position is via a non-contact referencing element. Referencing is only required following power up of the machine.

- ❖ Rotational Range: $\pm 180^{\circ}$
- ❖ Max Rotational Velocity: 25 rpm

The H axis forms the tool holding spindle and is mounted to the A/B axes and completes the virtual pivot assembly. Drive is provided via a DC frameless motor with position feedback from a rotary encoder. Spindle is cooled by external SMC chiller system. Tooling mounts via a $\varnothing 25\text{mm}$ hydrodehn chuck. The H axis also integrates a load cell arrangement to facilitate part probing essential for process stability and part/machine referencing.

- ❖ Speed Range: 10 to 2000rpm
- ❖ Polishing Head radii: Solid or Inflatable R20, R40
(Solid R2, R5, R10, Inflatable R80 optional¹)

¹ Fixturing may be required to allow the small tools to reach the surface of the component

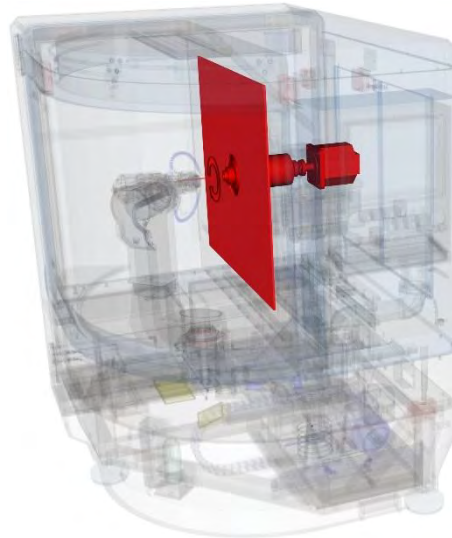


Figure 8: C Axis/Spindle

The C Axis forms the work piece mounting spindle and is mounted to the X-Y-Z Axes. The axis consists of rolling element bearings driven by a Brushless DC servo motor, with positional feedback provided by a precision absolute encoder. Spindle is cooled by external SMC chiller system.

The Spindle is supplied with a Ø25mm hydrodehn chuck for work piece mounting.

- ❖ Speed Range: 0 to 1000rpm
- ❖ Max Load Capacity: 15Kg
- ❖ Vacuum (Optional): -0.8bar maximum

6 Machine Enclosures

The Machine enclosures are provided as follows:

- ❖ Uncoated stainless steel polishing enclosure (internal surfaces)
- ❖ Slurry return drain passing through the granite base.
- ❖ Slide protection for the X, Y, and Z axes.
- ❖ Isolated machine electrical and pneumatic systems.
- ❖ Maintenance access to X, Y, and Z axes.
- ❖ Transit constraints.

7 Control System

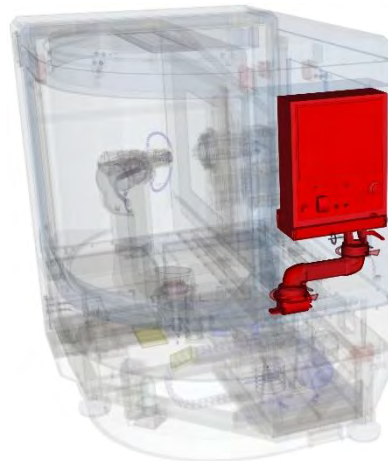


Figure 9: Control Console

Zeeko Fanuc (30i-B) System

- ❖ Industrialised PC with 15" Touch Color LCD Screen with Softkeys
- ❖ 5-axes interpolation (export controlled) with cubic, polynomial, and B-spline (NURBS) capability
- ❖ Designation of control paths: 1 path
- ❖ Least Command Increment: 1 μ m
- ❖ Processor: Panel i - Windows embedded Standard 7 OS
- ❖ Data Server option for up to 4GB NC programs

8 Guards, Covers & Safety Features

The equipment specified herein shall conform to requirements of EC and international safety regulations as required by current legislation.

Cover and guards will be provided to protect the operator from:

- ❖ Moving machine parts
- ❖ Slurry and spray

Covers will also protect machine elements from:

- ❖ Slurry and fluids
- ❖ Airborne dust and debris

Electrical interlocks will prevent opening of:

- ❖ The polishing enclosure door when the machine is in cycle.
- ❖ Electrical cabinet when the machine is energised
- ❖ MicroSMU drawer when the machine is in cycle.

An emergency stop button readily accessible to the machine operator

9 Chiller Unit

A Refrigerated 19" Euro-rack mounted de-mineralised water cooler is supplied integral to the machine and is used to control the temperature of the polishing media (SMU versions only).

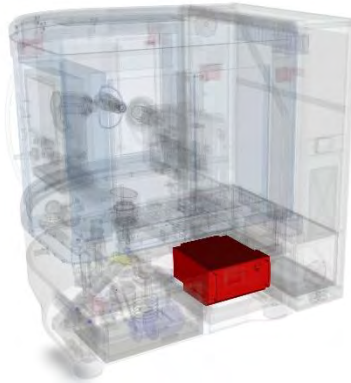


Figure 10: Integrated Chiller System

❖ Nominal capacity for 20°C fluid temperature :	540W @ 30°C ambient
❖ Max. heat rejection to air:	620 W
❖ Design fluid temperature:	15 to 25°C
❖ Ambient air temp. range:	15 to 40°C
❖ Control accuracy:	±0.75°C
❖ Capacity control:	Compressor on/off
❖ Fluid:	De-mineralised water
❖ Tank capacity:	3.6 litres

10 Micro Slurry Management Unit (MicroSMU)

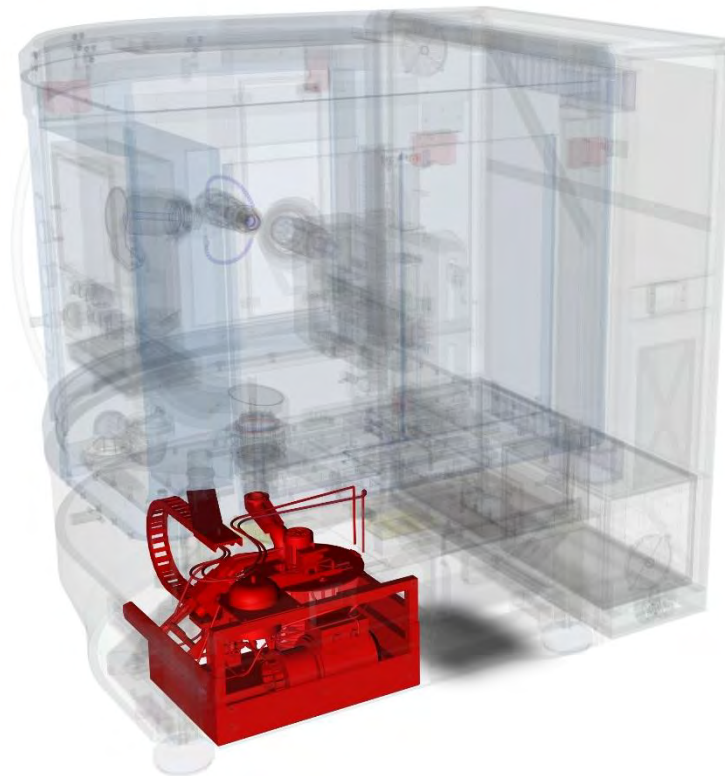


Figure 11: Integrated MicroSMU

- ❖ Max Flow Rate:
 - ⊕ 30 L/min – Standard Low Pressure Pump
 - ⊕ 8.7 L/min – Optional High Pressure Pump for ZeekoJet Polishing
- ❖ Pressure Variation: $\pm 2\%$
- ❖ Tank Capacity: 15 Litres

11 Peristaltic Pump System (Option)

The Zeeko mounted peristaltic slurry delivery system can be used to supply polishing slurry in either a closed loop or open loop, total loss system.

High flow rate Pump specification (recirculating or total loss):

- ❖ Flow rate: Min flow rate: 75ml/min
 Max flow rate: 280ml/min
- ❖ Reservoir capacity: 1 litre
- ❖ Tube Type: Ø4.8mm Masterflex PharMed BPT
 Long life, high acid/alkali resistance
- ❖ Agitation method: Magnetic stirrer.

Low flow rate pump specification (recirculating or total loss):

- ❖ Flow rate: Min flow rate: 8ml/min
 Max flow rate: 30ml/min
- ❖ Reservoir capacity: 1 litre
- ❖ Tube Type: Ø1.6mm Masterflex PharMed BPT
 Long life, high acid/alkali resistance

Agitation method: Magnetic stirrer.

12 ZeekoJet Polishing (Option)

H-axis is a 'combo head' capable of Classic polishing and additionally Fluid Jet Polishing (FJP). FJP specification is as follows:

- ❖ Bonnet and hydraulic chuck are removed and optional FJP adaptor is assembled. Adaptor has removable probe for probing routines.
- ❖ Nozzle bore range available: 0.25, 0.5, 1.0, 1.5mm
- ❖ Nozzle can be mounted axial or at 30° to H-axis.
- ❖ Maximum rated pressure is 20bar.

13 Summary Specification

13.1 General

General	Description
System Configuration	7 Axis CNC Optical Polishing Machine constructed on Polymer Granite Machine Base, capable of producing ultra-precise surfaces on a variety of optical materials and surface forms.
Work piece Capacity (1)	Nominal polishing envelope of 300x300x120mm
Base Structure	Polymer Granite
Control System	Fanuc 30i-B
Dimensions (No Accessories) WxDxH	1500mm x 2025mm x 2000mm
Suggested Install Dimensions	3000mm x 3500mm x 2100mm
Weight	3000Kg
Floor Load Requirements	Minimum loading 105,000Kg/m ² Floor must be even to <3mm/m ²
Environmental Requirements Min/Max Operating Temp. Max Operating Humidity Min/Max Storage Temp. Max Storage Humidity	15°C - 35°C (<2°C/hour Temperature Gradient) 75% RH Non Condensing -15°C - 50°C 80% RH Non Condensing
Power Supply Requirements	3Phase+N+E, 200/VAC 50/60Hz 4KW
Services Requirements	Clean dry air at 185L/min with minimum pressure of 6bar, Mains water for MicroSMU cleaning cycle
Noise Level	<50dB(A) Continuous
Safety	In accordance with EC Directives 2006/42/EC, 2004/108/EC (EMC) and 2006/95/CE (Low Voltage)

13.2 Linear Axes

Description	X	Y	Z
Slide Type	Precision Linear Motion Rails	Precision Linear Motion Rails	Precision Linear Motion Rails
Drive Type	Fanuc LiS 3000 Linear Motor	Fanuc 900D Linear Motor	Fanuc LiS 1500 Linear Motor
Feedback Type	Absolute Linear Encoder	Absolute Linear Encoder	Absolute Linear Encoder
Travel	±160mm	±160mm	+5mm , -135mm Max VP-Chuck Face Distance=(140)mm Min VP-Chuck Face Distance=(0)mm
Max Velocity	3000mm/min	3000mm/min	3000mm/min
Max Acceleration	250mm/sec ²	250mm/sec ²	250mm/sec ²
Positioning Accuracy	<10µm over full travel	<10µm over full travel	<10µm over full travel
Bi-direction Repeatability	<5µm	<5µm	<5µm
Straightness: Horizontal: Vertical:	<10µm over full travel <5µm over 100mm	<10µm over full travel <5µm over 100mm	<10µm over full travel <5µm over 100mm
Squareness	<50µm/m	<50µm/m	<50µm/m
Circularity	<50µm	<50µm	<50µm

13.3 Rotary Axes

Rotary Axes	A	B	H (Tool)	C (Workpiece)
Mounting	Epoxy-Granite Base	A Axis Arm	Virtual Pivot Assembly	Z Axis Carriage
Spindle/Axis	Axis	Axis	Spindle	Spindle & Axis
Cooled	Not Req'd	Not Req'd	Yes	Yes
Integral Services	N/A	N/A	Air (STD)/FJP (Optional)	Vacuum (Optional)
Probing	N/A	N/A	125N Load Cell	N/A
Drive	Servo drive via Harmonic CHA-32A with enhanced radial stiffness	Servo drive via Harmonic CHA-25A with enhanced radial stiffness	DC Frameless	Fanuc AiS 22 Direct Drive
Feedback Type	Motor Encoder	Motor Encoder	Rotary Encoder, 5000lines/min	Absolute Encoder
Speed Range	0-25rpm	0-25rpm	0-2000rpm	0-1000rpm
Load Capacity				15Kg
Maximum Inertial Load ²	N/A	N/A	N/A	2.0Kg*m ² @239rad/s ²
Positional Repeatability @ Motor	±1arcmin	±1arcmin	-	±1arcmin
Working Range	+115°,-50°	±180°	Continuous- bi directional	Continuous- bi directional
Radial Run-Out	Rotation of VP Setting ball mounted in H Axis Chuck and rotated about the Virtual Pivot < 40µm			<5µm
Axial Run-out				<10µm

13.4 Contact

For more information, please visit our website (www.zeeko.co.uk) or contact us via the following:

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² Maximum Inertial load in standard configuration. Variations may be possible with servo retuning – contact Zeeko for advice.