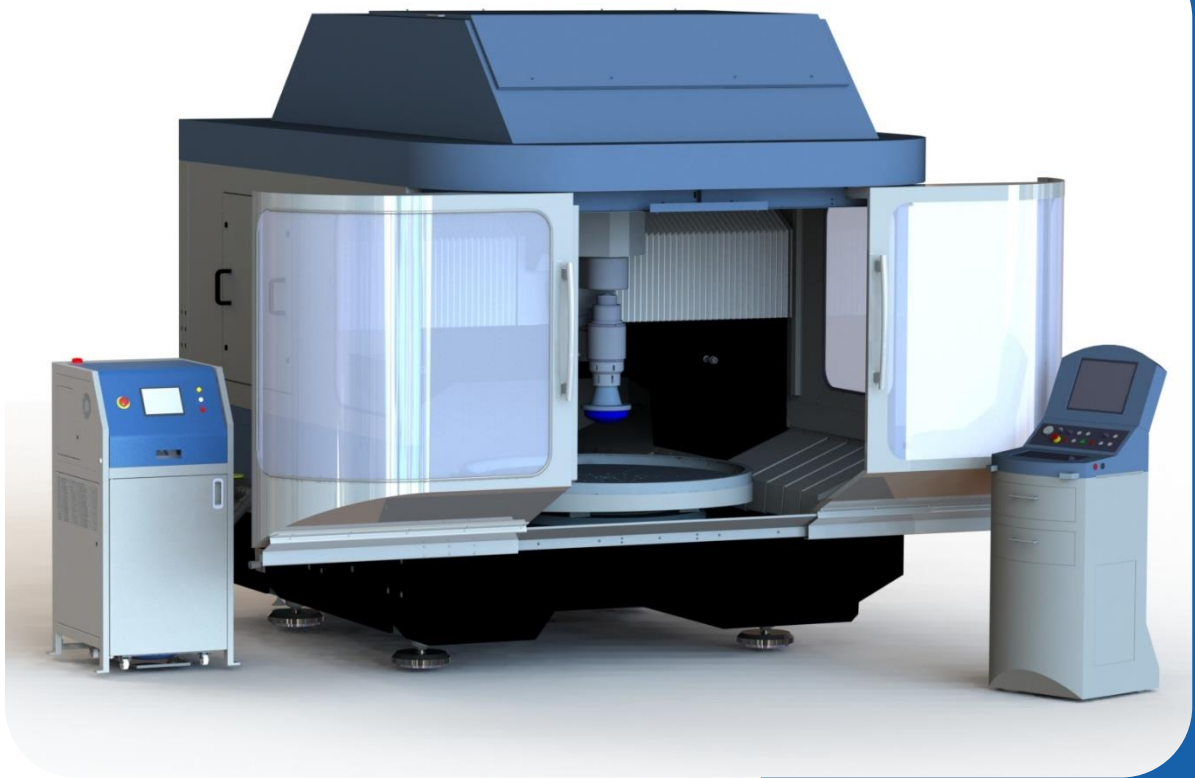




IRP1200 Mk1 - 7Axis Ballscrew Product Specification - Version 3, Release 4



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1 Machine Description

The IRP1200 is a 7-Axis CNC corrective polishing machine capable of producing ultra-precision surfaces on a wide range of materials and surface forms.

Machine Dimensions (without accessories)

- ❖ Mass = 14,000 kg.
- ❖ Size = 2,800 x 3,600 x 3,000 mm (W x D x H)

Workpiece Capacity

The optics that can be manufactured on the IRP1200 machine are as follows:

- ❖ Freeform parts of up to: 1200 x 1200 x 700 mm
- ❖ Rotationally Symmetrical parts of up to:
 - Ø 1,600mm using hypotenuse or synchro-spiral polishing
 - Ø 1,200mm using raster mode polishing
- ❖ Maximum of 500kg

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 epoxy-granite bridge.
- ❖ Y is a linear axis which mounts horizontally to the base and is aligned perpendicular to the X-Axis.
- ❖ Z is a linear axis which mounts vertically from the X-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 vertically to the base.
- ❖ A, B and H are rotational axes configured such that the spherical polishing tool, mounted on the H-Axis, rotates about a point in space called the virtual pivot point. This three axes assembly mounts to the Z-Axis.

3 Epoxy Granite Machine Base and Bridge

The machine base and bridge are precision cast and machined polymer-granite composite structures that provide excellent thermal stability and vibration damping characteristics. These two key machine elements incorporate the following features:

- ❖ The machine base is a precision cast and machined epoxy granite composite structure.
- ❖ Moulded-in stainless steel inserts for mounting and alignment of the X and Y axes, handling, and transportation.
- ❖ Threaded stainless steel inserts for mounting the polishing and electrical enclosures.
- ❖ Moulded-in feeds for electrical supply and control cables, compressed air, and slurry supply and return.

4 Linear Axes

Each axis is mounted on a pair of precision THK linear motion rails and driven via an AC servo motor and precision ground ballscrew. Home positions measured via absolute rotary encoders or linear encoders

- ❖ Slide type: Precision caged ball linear motion rails
- ❖ Travel (X-Axis): ± 650 mm (total 1,300 mm)
- ❖ Travel (Y-Axis) ± 650 mm (total 1,300 mm)
- ❖ Travel (Z-Axis) -495 mm, +5 mm
- ❖ Drive system: AC servo driven, caged ball, precision C5 grade or equivalent ballscrew
- ❖ Max velocity: 3000 mm/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 Z-Axis.

5.1 A-AXIS

The A-Axis is mounted to the Z-Axis 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: $\pm 270^\circ$
- ❖ Max Rotational Velocity: 10 rpm
- ❖ Positional accuracy: ± 1 arcmin

5.2 B-AXIS

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: 10 rpm
- ❖ Positional accuracy: ± 1 arcmin

5.3 H-AXIS

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. The spindle is cooled by an external chiller system.

Tooling mounts via a $\varnothing 40$ mm chuck.

- ❖ Speed Range: 0, 10 to 2000 RPM
- ❖ Polishing Head radius: R20, R40, R80, R160, R320 (optional)

5.4 C-AXIS

The C-Axis forms the work piece mounting spindle and is mounted to the base. The C-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 an Ø1,225 mm turntable and Ø40 mm hydraulic chuck for work piece mounting. The chuck may be used via an adapter to the table.

- ❖ Speed Range: 0 to 150 RPM
- ❖ Max Load Capacity: 500 kg¹
- ❖ Vacuum (Optional): -0.8bar maximum

¹ As the workpiece load approaches the maximum capacity, all velocities and accelerations will be reduced to meet safe working conditions.

6 Machine Enclosures

The Machine enclosures are provided as follows:

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

7 Control System

Zeeko Fanuc (30i-B) System

- ❖ Fanuc Multi-Axis Controller, 30i Series CNC
- ❖ 30i-B Basic unit, Stand-Alone Type
- ❖ Designation of Number of Axes – 7 Axes
- ❖ Designation of Control Path – 1 Path
- ❖ 1µm Minimum Axis Increment System
- ❖ Multi-Axis Spline Capability – AI Contour Control II – NURBS Interpolation
- ❖ Compensation – Straightness, Pitch Error
- ❖ Panel-i – Windows 10 IoT Enterprise OS or more recent
- ❖ Zeeko Dedicated Graphical User Interface
- ❖ 15.0" Colour LCD, with Softkeys, with Touch Panel
- ❖ Ethernet Port for Data I/O and/or Remote Diagnostics / Maintenance
- ❖ USB Socket
- ❖ Data Server with Compact Flash Card, 16GB
- ❖ Program Transfer Tool Software

8 Covers, Guards & 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 doors when the machine is in cycle.
- ❖ Electrical cabinet when the machine is energised

An emergency stop button readily accessible to the machine operator

9 Summary Specification

9.1 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
Workpiece Capacity (1)	up to 1,200 x 1,200 x 700 mm Freeform Parts up to Ø 1,600mm Rotationally Symmetrical part using hypotenuse or synchro-spiral polishing up to Ø 1,200mm Rotationally Symmetrical part using raster mode polishing Max 500 kg (optional) Work Vacuum 0...-0.8bar
Base Structure	Polymer-Granite
Control System	Fanuc 30i - B
Dimensions (No Accessories)	2,800 x 3,600 x 3,000 mm (W x D x H)
Suggested Install Dimensions	6,500 x 5,600 x 3,200 mm (W x D x H)
Machine Weight	14,000 kg
Floor Load Requirements	Minimum loading 100,000 kg/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	3 Phase + E, 400 Vac ± 3%, 50-60 Hz
Machine Power Rating	27 kW, 39 A
Services Requirements	Clean dry air at 400 litres / min with minimum pressure of 6 bar
Product Marking	In accordance with UKCA Directives: The Supply of Machinery (Safety) Regulations 2008 The Electrical Equipment (Safety) Regulations 2016; Electromagnetic Compatibility Regulations 2016; The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

9.2 Linear Axes

Description	X	Y	Z
Slide Type	Precision Linear Motion Rails	Precision Linear Motion Rails	Precision Linear Motion Rails
Drive Type	Servo Driven precision C5-grade or equivalent ballscrew	Servo Driven precision C5-grade or equivalent ballscrew	Servo Driven precision C5-grade or equivalent ballscrew
Feedback Type	Absolute Linear Encoder (std)	Absolute Linear Encoder (std)	Absolute Linear Encoder (std)
Travel	± 650 mm (total 1,300 mm)	± 650 mm (total 1,300 mm)	-495 mm, +5 mm
Max Velocity	3,000 mm/min	3,000 mm/min	3,000 mm/min
Max Acceleration	250 mm/sec ²	250 mm/sec ²	250 mm/sec ²
Positioning Accuracy	<50 µm over full travel	<50 µm over full travel	<50 µm over full travel
Bi-direction Repeatability	<5 µm	<5 µm	<5 µm
Straightness: Horizontal: Vertical:	<30 µm over full travel <5 µm over 100mm	<30 µm over full travel <5 µm over 100mm	<30 µm over full travel <5 µm over 100mm
Squareness	<50 µm/m	<50 µm/m	<50 µm/m
Circularity	<50 µm	<50 µm	<50 µm

9.3 Rotary Axes

Rotary Axes	A	B	H (Tool)	C (Workpiece)
Mounting	Z-Axis Carriage	Virtual Pivot Arm	Virtual Pivot Assembly	Base
Spindle/Axis	Axis	Axis	Spindle & Axis	Spindle & Axis
Cooled	Not Required	Not Required	Yes	Yes
Drive	AC Servo Drive Harmonic Drive Unit with Enhanced Radial Stiffness	AC Servo Drive Harmonic Drive Unit with Enhanced Radial Stiffness	Emoteq DC Frameless Direct Drive	DC Frameless Direct Drive
Feedback Type	Incremental Motor Encoder	Incremental Motor Encoder	Incremental Encoder 5,000 lines	Heidenhain Absolute Angle Encoder
Speed Range	0...10 rpm	0...10 rpm	0, 10...2000 rpm	0...150 rpm (Turntable)
Load Capacity Maximum Inertial Load ²	N/A	N/A	N/A	500 kg 75 kg*m ² @10rad/s ²
Positional Accuracy	±1 arcmin	±1 arcmin	-	±2.5 arcsecs
Working Range	± 270°	± 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 < 20µm			<10 µm
Axial Run-out				<40 µm (@R=500)

9.4 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.