



IRP800 - 7Axis Ballscrew

Product Specification - Version 2, Release 1



Zeeko

Rev. 101014

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1 Machine Description

The IRP800 is a 7-axis CNC polishing/form generating machine capable of producing ultra-precision surfaces on a wide range of materials and surface forms. The machine includes an option for roof doors in order that an optical test tower with a tower-mounted interferometer can provide an uninterrupted clear aperture view of the workpiece on the rotary table.

A second feature is the option for a secondary rotary table top that mounts on the C-axis and allows "hypotenuse polishing" of (rotationally symmetric optics only) a maximum diameter of approximately 0.85 metre (geometry limited)

Machine Dimensions: (without accessories)

- Size: 2050mm wide x 2700mm deep x 2850mm high.
- Mass: 8000kg.

Workpiece Size Constraints

The optics that can be manufactured on the IRP800 machine are as follows:

- Freeform parts of up to: 800mm x 800mm x 350mm
- Rotationally Symmetrical parts of up to: Ø1120mm

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 poly-granite bridge.
- ❖ Y is a linear axis which mounts horizontally to the poly-granite 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 Y-axis.
- ❖ 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 Polymer Granite Machine Base and Bridge

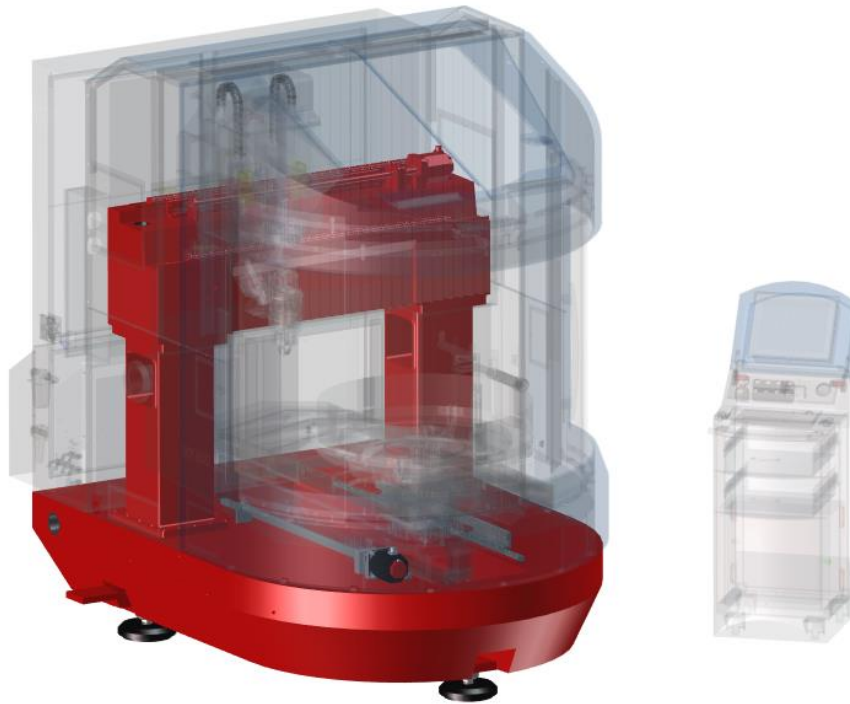


Figure 1: Polymer Granite Base & Welded Steel Frame

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

- ❖ Moulded-in stainless steel inserts for mounting and alignment of the X and Y axes, machine lifting, 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 optional linear encoders

- ❖ Slide type: THK linear motion rails
- ❖ Travel (X Axis): $\pm 475\text{mm}$
- ❖ Travel (Y Axis) $\pm 475\text{mm}$
- ❖ Travel (Z Axis) 400mm
- ❖ Drive system: AC servo driven precision ground ballscrew
- ❖ Max velocity: 3000mm/min

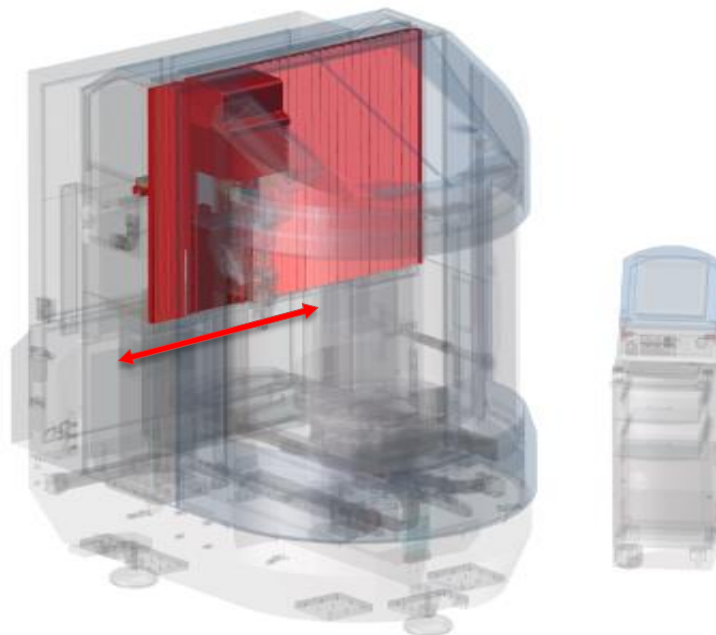


Figure 2 : X-AXIS

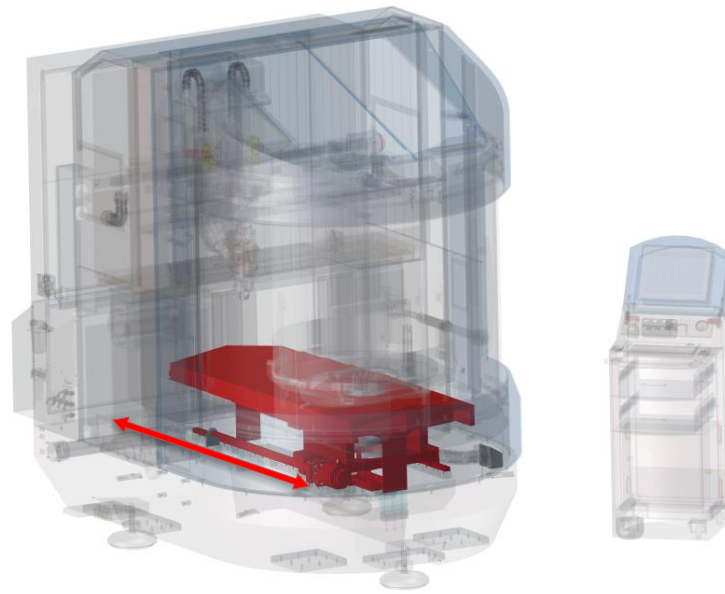


Figure 3 : Y-AXIS

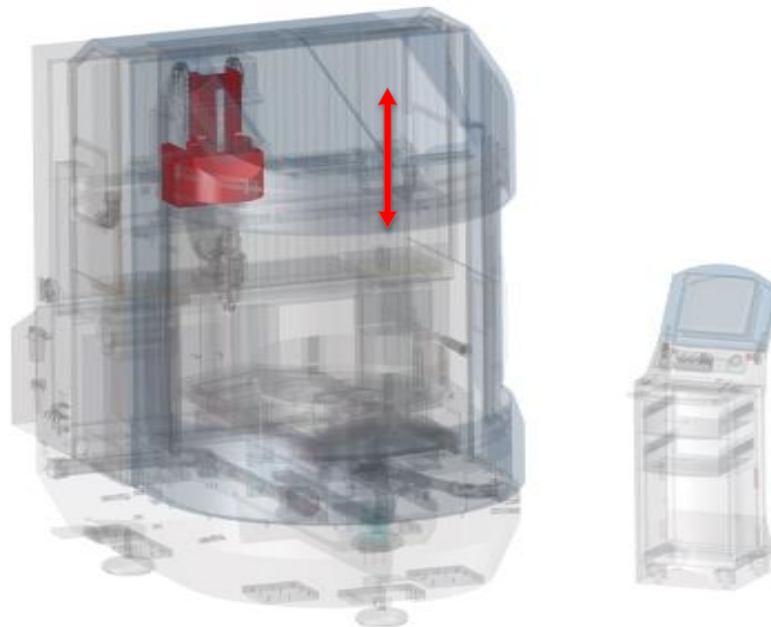


Figure 4 : Z-AXIS

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

5.1 A-AXIS

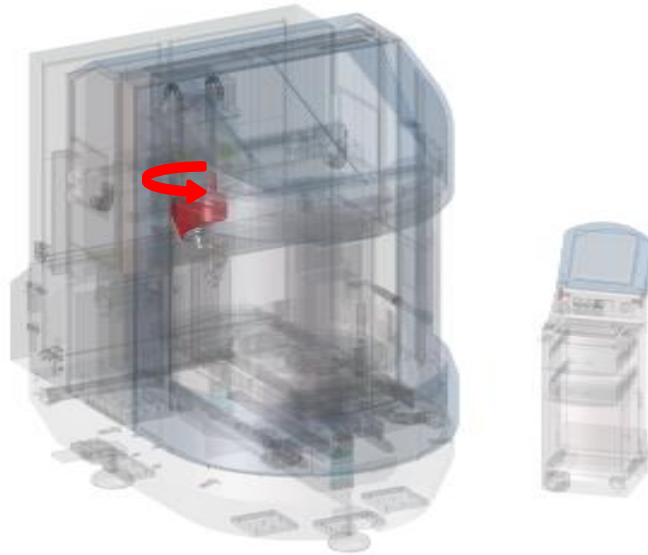


Figure 5: A Axis

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: 25 rpm

5.2 B-AXIS

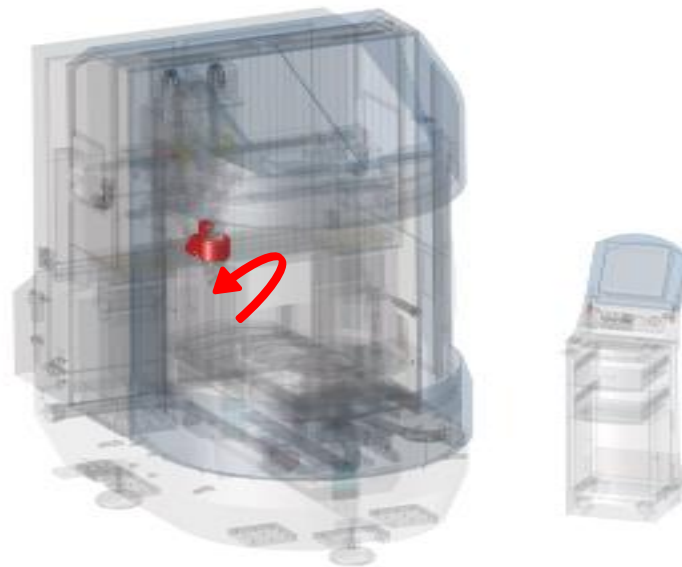


Figure 6 : B-AXIS

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: 20 rpm
- ❖ Positional accuracy : $\pm 1\text{arcmin}$

5.3 H-AXIS



Figure 7 : 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. Spindle is cooled by external SMC chiller system.

Tooling mounts via an Ø40mm chuck.

- ❖ Speed Range: 10 to 2000
- ❖ Polishing Head radius: Solid or Inflatable R20, R40, Inflatable R80, 160

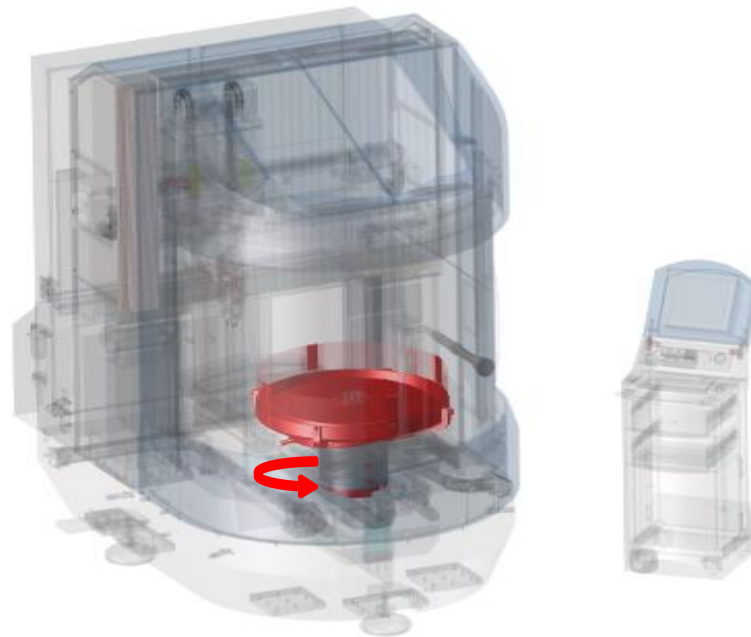


Figure 8: C Axis/Spindle Including Slurry Tray

The C Axis forms the work piece mounting spindle and is mounted to the Y-Axis. 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 an Ø800mm turntable or/and Ø40mm Schunk chuck for work piece mounting.

- ❖ Speed Range: 0 to 250 rpm
- ❖ Max Load Capacity: 300kg
- ❖ 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.

7 Control System

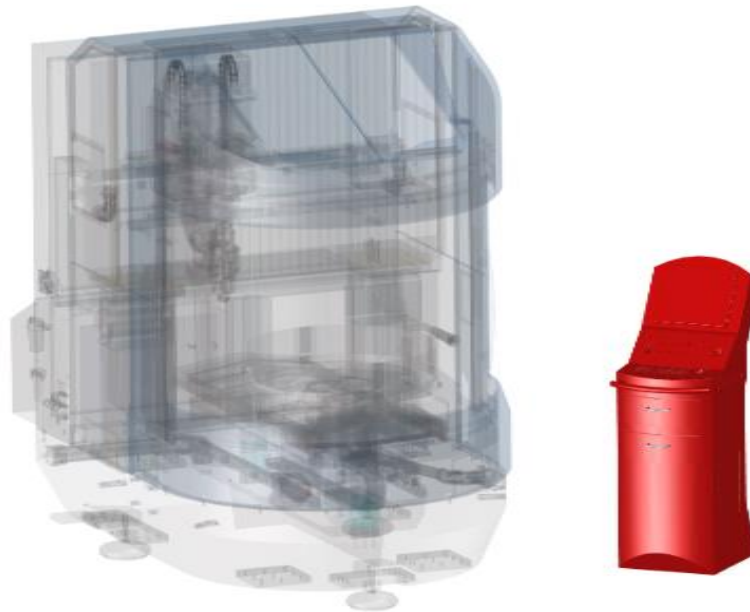


Figure 9: Control Console

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 Embedded Standard 7 OS
- ❖ 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, 4GB
- ❖ Program Transfer Tool Software

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

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 Quartzite Machine Base, capable of producing ultra-precise surfaces on a variety of optical materials and surface forms.
Work piece Capacity (1)	Freeform Parts of up to: 800mm x 800mm x 350mm Rotationally Symmetrical part of up to: 1120mm in diameter
Base Structure	Polymer Quartzite
Control System	Fanuc 30i - MB
Dimensions (No Accessories)	2050mm wide x 2700mm deep x 2850mm high
Suggested Install Dimensions	4450mm x 4350mm x 3850mm
Weight	8000Kg
Floor Load Requirements	Minimum loading 165,000Kg/m2 Floor must be even to <3mm/m2
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, 200/220/240/420/480VAC 50/60Hz 12KW
Services Requirements	Clean dry air at 350L/min with minimum pressure of 6bar
Noise Level	<50bB(A) Continuous
CE Marking	In accordance with EC Directives 2006/42/EC, 2004/108/EC (EMC) and 2006/95/CE (Low Voltage)

9.2 Linear Axes

Description	X	Y	Z
Slide Type	THK Linear Motion Rails	THK Linear Motion Rails	THK Linear Motion Rails
Drive Type	Servo Driven precision ground ballscrew	Servo Driven precision ground ballscrew	Servo Driven precision ground ballscrew
Feedback Type	Absolute Rotary Encoder (std)	Absolute Rotary Encoder (std)	Absolute Rotary Encoder (std)
Travel	950mm	950mm	400mm
Max Velocity	3000mm/min	3000mm/min	3000mm/min
Max Acceleration	250mm/sec ²	250mm/sec ²	250mm/sec ²
Positioning Accuracy	<50µm over full travel	<50µm over full travel	<50µm over full travel
Bi-direction Repeatability	<5µm	<5µm	<5µm
Straightness: Horizontal: Vertical:	<30µm over full travel <5µm over 100mm	<30µm over full travel <5µm over 100mm	<30µm over full travel <5µm over 100mm
Squareness	<50µm/m		
Circularity	<50µm		

9.3 Rotary Axes

Rotary Axes	A	B	H (Tool)	C (Workpiece)
Mounting	Z Axis Carriage	Virtual Pivot Arm	Virtual Pivot Assembly	Base (option of Tumbletable or Ø40 Schunk Chuck)
Spindle/Axis	Axis	Axis	Spindle	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	Emoteq DC Frameless Direct Drive
Feedback Type	Motor Encoder	Motor Encoder	Rotary Encoder, 5000lines min	Heidenhain Absolute Angle Encoder
Speed Range	0-25rpm	0-25rpm	10-2000rpm	0-250rpm (Tumbletable) 0-900rpm (Schunk chuck)
Load Capacity	N/A	N/A	N/A	300Kg
Maximum Inertial Load ¹				2.0Kg*m ² @20rad/s ²
Positional Accuracy	±1arcmin	±1arcmin	-	±2.5arcsecs
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 < 5µm			<5µm
Axial Run-out				<20µm

¹ Maximum Inertial load in standard configuration. Variations may be possible with servo retuning – contact Zeeko for advice.

10 Contact

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