ZEEKO

Specification Manual

IRP200 MkI F 7-Axis

Version 7, Rev b

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Contents

Safety considerations

The following signs are used throughout the manual to depict areas of safety or general instruction. Please make yourself aware of these signs and take careful consideration when carrying out the specified maintenance tasks.

WARNING: *Identifies a potentially dangerous situation which may cause loss of life, serious harm or damage.*

ATTENTION: *Signifies a potentially dangerous situation which may cause injury or serious damage.*

NOTE: *Signifies importance or attention as something to assist memory or communicate a brief message.*

TIP: *Specifies information that could be useful and save you unnecessary time and effort.*

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 = 2500 Kg.
- Dimensions = 1800 x 1850 x 1960 (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.
- 3-point mounting for polymer-granite base.

Arrangement of the axis

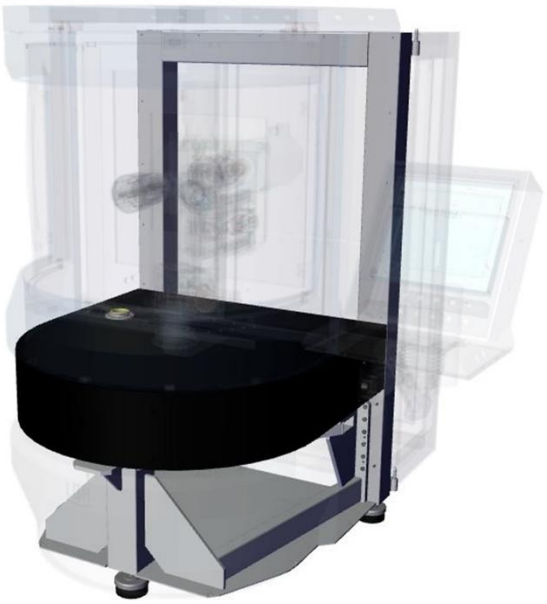
The arrangement and definition of the 7 CNC axes is as follows:

- 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.

Polymer granite machine base

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.



Linear axis

X axis

Y axis

Z axis

Each axis is mounted on a pair of precision linear motion rails and driven via an AC servo motor and precision ballscrew. Home position measured via absolute rotary encoder.

- Slide type: Precision linear motion rails.
- Travel (X Axis): ± 145 mm.
- Travel (Y Axis) ± 120 mm.
- Travel (Z Axis) 120 mm.
- Drive system: AC servo driven precision ballscrew.
- Positioning feedback: Home position - absolute rotary encoder
- Max velocity: 3000 mm/min

Rotary axis and 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.

A axis B axis H axis

The A-axis is mounted to the base via a Twinspin 140 reducer unit, driven by an AC servo motor. Referencing of the position is via the motors absolute encoder. Referencing is only required following power up of the machine.

- Rotational Range: -55 ° to +110 °
- Max Rotational Velocity: 25 rpm

The B axis is mounted to the A axis and is belt driven via a Twinspin80 reducer unit, driven by an AC servo motor. Referencing of the position is via the motors absolute encoder. Referencing is only required following power up of the machine.

- Rotational Range: ±180 °
- 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. Spindles are cooled by external SMC chiller system.

Tooling mounts via a hydrodehn chuck (12 mm or 25 mm available, dependent on application). 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 3000
- Polishing Head radii: Solid or Inflatable R20, R40
  Solid R2, R5, R10, Inflatable R80 optional

NOTE: *Fixturing may be required to allow the small tools to reach the surface of the component.*

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. The spindle is cooled by an external SMC chiller system.

The Spindle is supplied with a Ø25 mm hydrodehn chuck for work piece mounting.

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

Control system

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 µm.
- Processor: Panel i - Windows embedded OS.
- Data Server option for up to 4 GB NC programs.
- On-screen servo check facility for full diagnostics and system performance check.
- Ethernet port for data I/O and/or remote diagnostics / maintenance.
- USB socket.
- Program Transfer Tool Software.

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.

Guards, covers and safety features

The equipment specified herein shall conform to the 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.

Electrical specification

Power supply

The machine is designed for operation on 3-phase, 4 wire systems (3 phases + Earth). The machine can accept the following mains voltage:

- 3-phase + Earth, 400 V ± 5%, 50 or 60 Hz. 3.7 kVA

NOTE: *If the local electrical power supply standard does not meet this specification, then an electrical power transformer must be used between the local electrical supply and the IRP machine to the following output-side recommendation:*

NOTE: *The 3.7 kVA rating is nominal and may be affected by customized design requirements. If this is the case, then Zeeko will notify customers at the time of ordering.*

Compressed air

The IRP200 machine operates with compressed air to fulfil the following functions:

- Air purges to axes and joints exposed to polishing slurries.
- Bonnet (polishing tool) air pressure.
- Vacuum systems for vacuum work holding where fitted (chucks).
- Pneumatic systems for the control of fluid systems.
    - Minimum input pressure 6 bar.
    - Maximum input pressure 8 bar.
    - Volumetric requirement 185 L / min. (air purges to max.).

Mist separators are fitted internally to all machines.

Environmental specification

The IRP200 must be installed inside a room with the following characteristics:

Temperature and humidity

- Operating Temperature: 20 °C +/- 1.0 °C
- Max. Operating Humidity: 80 % RH, non-condensing
- Storage Temperature: -15 – 50 °C
- Max. Storage Humidity: 80% non-condensing
- Max. Temperature Gradient: <2 °C / hour
  - If necessary provide adequate air condition.
- Recommended Temperature: 21 °C ± 0.5 °C

Cleanliness

The IRP machines do not require sitting in an ISO class cleanroom. However, we recommend that the machine is sited in a separate room to:

- Rooms containing conventional milling and grinding machines.
- Rooms containing diamond turning machines.
- Rooms subject to metal swarf or grinding dust.
- Rooms subject to any other processes that generate airborne particulate matter.

The room should be clean, but not necessarily a cleanroom as classified by ISO. IRP machines typically use Cerium Oxide slurry as the polishing medium and when this dries on surfaces, it can produce a dust which would be classed as a contaminant in ISO-class cleanrooms. It is for this reason we recommend that if you require the rooms to be clean, you adhere to practices for cleanrooms of ISO class 8 or 9, but without the rigorous filtering required. The resulting air changes and also cleanliness protocols will ensure a room that is clean to a very high standard.

Room vibration requirements

Each IRP machine is equipped with passive vibration isolation feet. The IRP 200 is no different in this respect. To ensure best results, we recommend a vibration environment corresponding to:

- Residential Day (ISO).

Summary specification

General	Description
System Configuration	7 Axis CNC Optical Polishing Machine constructed on Polymer Granite Machine Base with steel supporting frame capable of producing ultra-precise surfaces on a variety of optical materials and surface forms.
Work piece Capacity (1)	Nominal polishing envelope of 290 x 240 x 120 mm
Base Structure	Polymer Granite
Control System	Fanuc 30i-B
Dimensions (No Accessories) W x D x H	1800 mm x 1850 mm x 1960 mm
Suggested Install Dimensions	3725 mm x 3850mm x 2200 mm
Weight	2500 kg
Floor Load Requirements	Minimum point loading 170,000 kg/m^2 Floor must be even to <3 mm/m^2
Environmental Requirements Min/Max Operating Temp. Max Operating Humidity Min/Max Storage Temp. Max Storage Humidity	 20 °C +/- 1.0 °C (<2 °C/hour temperature gradient) 80 % RH non condensing -15 °C – 50 °C 80 % RH non condensing
Power Supply Requirements	3Phase+E, 400 V ± 5% - 50/60Hz. 3.7 kVA (customer must supply a transformer or power supply to meet this specification)
Services Requirements	Clean dry air at 185 L/min with minimum pressure of 6bar
Noise Level	<50 dB(A) Continuous
Safety	In accordance with EC Directives 2006/42/EC, 2004/108/EC (EMC) and 2006/95/CE (Low Voltage)

Linear axes

Description	X	Y	Z
Slide Type	Precision Linear Motion Rails	Precision Linear Motion Rails	Precision Linear Motion Rails
Drive Type	AC Servo driven Ø35-6 precision ballscrew (Grade C5)	AC Servo driven Ø35-6 precision ballscrew (Grade C5)	AC Servo driven Ø35-6 precision ballscrew (Grade C5)
Feedback Type	Absolute Rotary Encoder	Absolute Rotary Encoder	Absolute Rotary Encoder
Travel	±145 mm	±120 mm	+5 mm , -115 mm Max VP – Chuck Face Distance = (152.6) mm Min VP – Chuck Face Distance = (32.6) mm
Max Velocity	3000 mm/min	3000 mm/min	3000 mm/min
Max Acceleration	250 mm/sec^2	250 mm/sec^2	250 mm/sec^2
Positioning Accuracy	<10 µm over the full travel	<10 µm over the full travel	<10 µm over full travel
Bi-direction Repeatability	<5 µm	<5 µm	<5 µm
Straightness: Horizontal: Vertical:	<10 µm over the full travel <5 µm over 100 mm	<10 µm over the full travel <5 µm over 100 mm	<10 µm over full travel <5 µm over 100 mm
Squareness	<50 µ/m	<50 µ/m	<50 µ/m
Circularity	<50 µm	<50 µm	<50 µm

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 / (FJP Optional)	Vacuum (Optional)
Probing	N/A	N/A	125 N Load Cell	N/A
Drive	Fanuc β driven TwinSpin 140 speed reducer unit	Fanuc β driven TwinSpin 80 speed reducer unit	Emoteq DC Frameless	Direct Drive
Feedback Type	Motor Encoder	Motor Encoder	Rotary Encoder, 5000 lines/min	Absolute Encoder
Speed Range	0-25 rpm	0-25 rpm	10-3000 rpm	0-1000 rpm
Load Capacity Maximum Inertial Load[1]	N/A	N/A	N/A	15 Kg 2.0 Kg*m^2@239 rad/s^2
Positional Repeatability @ Motor	±1 arcmin	±1 arcmin	-	±1 arcmin
Working Range	-55 ° to +110 °	±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			<5 µm
Axial Run-out				<10 µm

[1] Maximum Inertial load in standard config. Variations are possible with servo retuning - contact Zeeko for advice

Contact

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