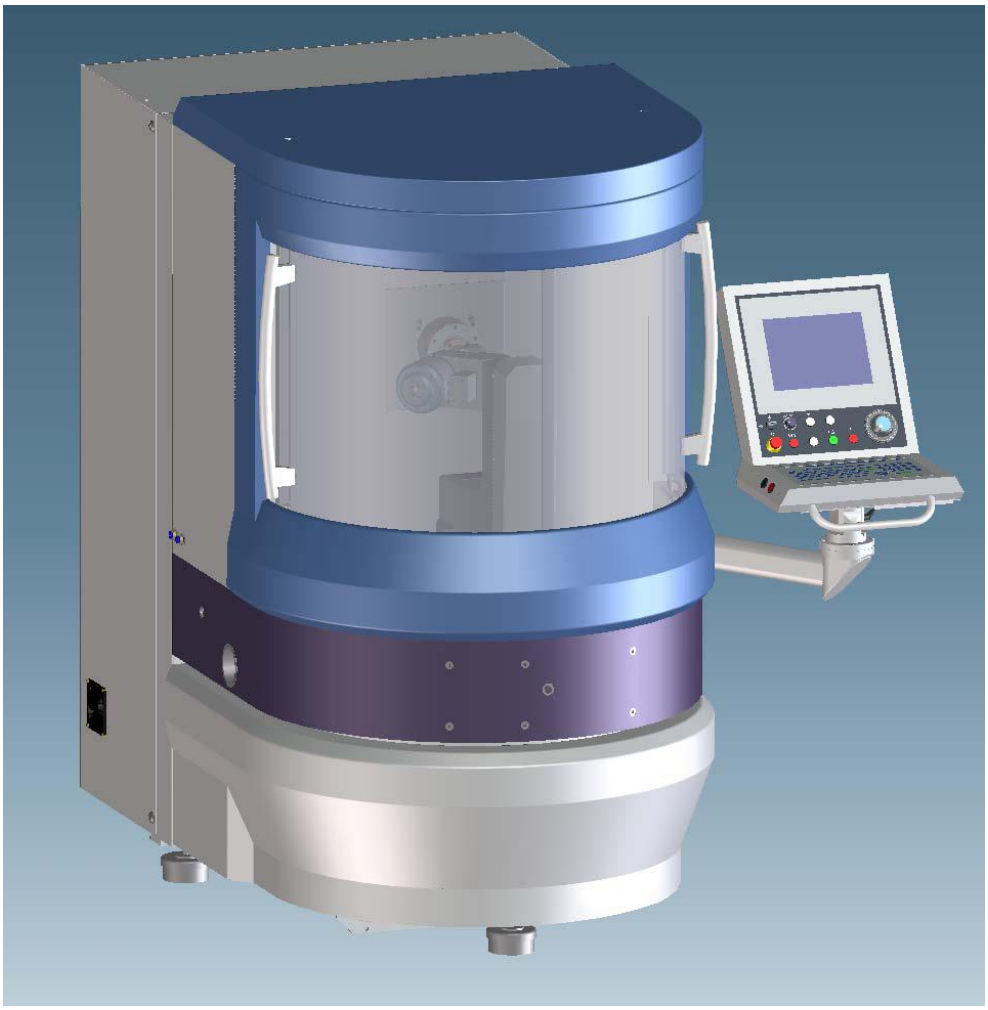
ZEEKO Ltd

IRP 200 Specification – Fanuc 30i-B Controller



Version R4

1 Machine Description

The IRP 200 is a 7 axis CNC optical polishing machine capable of producing ultra-precise surfaces on a variety of optical materials and surface forms. The machine axes can be used for traditional spiral polishing or raster polishing within a total envelope size of 290x240x120.

2 Contents

3 Welded Steel Base Frame

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

- 3 point floor mounting.
- Built in mounting for electrical and pneumatics enclosures.
- 3 point mounting for poly-quartzite base.

4 Polymer Quartzite Machine Base

The machine base is a precision cast and ground epoxy quartzite composite structures that provide excellent thermal stability and vibration damping characteristics. This key structural machine elements incorporates the following features:

- Threaded inserts and molded alignment features for X axis and VP mounting.

- Threaded inserts and features for:
  - Interferometer mounting
  - Polishing and electrical enclosure mounting
  - Control console

- Moulded feed-through for:
  - Electrical cables
  - Slurry drainage and return
  - Machine lifting and handling

5 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-quartzite base.
- Y is a linear axis which mounts vertically to the X axis carriage and aligned perpendicular to the X axis.
- Z is a linear axis which mounts 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 vertically to the Z axis.
- A, B and H are rotational axes configured such that the spherical polishing head (H axis) rotates through a point in space call the virtual pivot. This three axes assembly mounts to the quartzite base.

6 X and Y axes

Axis specification is as follows:

- Slide type: THK's SNS 25 C linear motion rails
- Travel: X axis 290mm Y axis 240mm
- Drive system: AC servo driven Ø35 - 5 precision ground ballscrew.
- Home position via absolute rotary encoder
- Axis accuracy:
  - Horizontal straightness: <20µm over full travel
    <5µm over 100mm
  - Vertical straightness: <20µm over full travel
    <5µm over 100mm
- Axis positioning error: < 10µm over full travel
- Bi-dir Rep: < 5µm
- Axis performance (CNC Settings):
  - Max velocity: 3000mm/min
  - Max acceleration 250mm/s²

7 Z Axis

Axis specification is as follows:

- Slide type: THK's SNS 35 C linear motion rails
- Travel: 120mm
- Drive system: AC servo driven, Ø32 – 5 precision ground ballscrew
- Positioning feed-back: absolute rotary encoder
- Home position via absolute rotary encoder.
- Axis accuracy:
  - Horizontal straightness: <10µm over full travel
<5µm over 100mm
  - Vertical straightness: <10µm over full travel
<5µm over 100mm
- Axis positioning error: < 10µm over full travel
- Bi-dir Rep: < 5µm
- Axis performance (CNC Settings):
  - Max velocity: 3000mm/min
  - Max acceleration: 250mm/s²

8 Alignment of the axes

• Circular interpolation	**X/Y**	**X/Z**	**Y/Z**
Total circularity error (mm)	<0.05	<0.05	<0.05

• Squareness			
Total squareness error (mm/m)	<0.05	<0.05	<0.05

9 A Axis

The first rotational element of the virtual pivot assembly. The specification is as follows:

- Mounting: Z axis carriage
- Drive system: AC servo driven Twinspin140 speed reducer unit
- Rotational range: +110° → -60° (Total Range: 170°)
- Rotational accuracy: ± 1 arcmin (Component Specification)
- Max rotational velocity: 25 rpm (CNC Settings)
- Max angular acceleration: 2000 degree/sec² (CNC Settings)
- Home position from zero position on absolute encoder.

10 B Axis

The Second rotational element of the virtual pivot assembly. The specification is as follows:

- Mounting: Virtual pivot arm
- Drive system: AC servo driven Twinspin80 speed reducer unit
- Rotational range: ± 180º
- Rotational accuracy: ± 1 arcmin (Components Specification)
- Max rotational velocity: 25 rpm (CNC Settings)
- Max angular acceleration: 2000 degree/sec² (CNC Settings)
- Home position from zero position on absolute encoder.

11 Polishing Head (H Axis).

An interchangeable rotating thin wall membrane polishing head with integral part probing capabilities and variable internal pressure providing independent control of contact area and pressure. The specification is as follows:

- Max rotational speed: 10 to 3000 rpm (CNC Settings)
- Max acceleration: 166.67 degree/sec² (CNC Settings)
- Velocity feed-back: Rotary encoder, 5000 lines min
- Direction of rotation: Bi-directional
- Polishing head radii 20mm, 40mm
- Polishing head pressure range:
  - R20 polishing head: 0.01 to 0.4 MPa
  - R40 polishing head: 0.01 to 0.3 MPa
- Head tool holding: Ø25 hydraulic chuck
- Standard Deviation for Part probing repeatability:
  - Solid metal probe: 2µm
  - R20 polishing head @ 0.1 Mpa 3µm (1.2mm LP66 cloth)
  - R40 polishing head @ 0.1 MPa 5µm (1.2mm LP66 cloth)
- Force transfer mechanism: Radially constrained metal diaphragms.

12 Work-piece Spindle (C Axis)

The specification is as follows:

- Spindle type: Water cooled with rolling element bearings
- Drive system: AC servo driven, direct drive
- Positioning feed-back: Absolute encoder
- Speed range: 0 to 1000 rpm (CNC Settings)
- Max acceleration: 83.333 degree/sec² (CNC Settings)
- Positioning accuracy: ± 1 arcmin
- Maximum throat diameter: 200mm plano surface
- Work holding: Ø25 hydraulic chuck
- Max load capacity: 15kg
- Radial and axial stiffness: >500N/µm
- Rotational motion errors:
  - Radial TIR: <5µm
  - Axial TIR @ r = 150mm <10µm

13 Machine Enclosures

The Machine enclosures will fully sealed and water tight and provide for the following:

- Slurry return drain passing through the quartzite base.
- Slide protection for the X, Y, and Z axis.
- Isolated machine electrical and pneumatic systems.
- Maintenance access to X, Y, and Z slides.
- Transit constraints for the quartzite base.

14 Guards, Covers, and 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
- Electrical interlocks will prevent opening of the following:
  - The polishing enclosure door when the machine is in motion.
  - Electrical cabinet when the machine is energised.
- An emergency stop button readily accessible to the machine operator.

15 Control System - Fanuc

- Fanuc Multi-Axis Controller, 30i Series CNC
- 30i-B Basic unit, Stand-Alone Type
- Designation of Number of Axes – 7 Axes
- Designation of Control Paths, 1 Path
- 1 um 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
- On-screen servo-check facility for full diagnostics and system performance check
- 15.0” Color 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