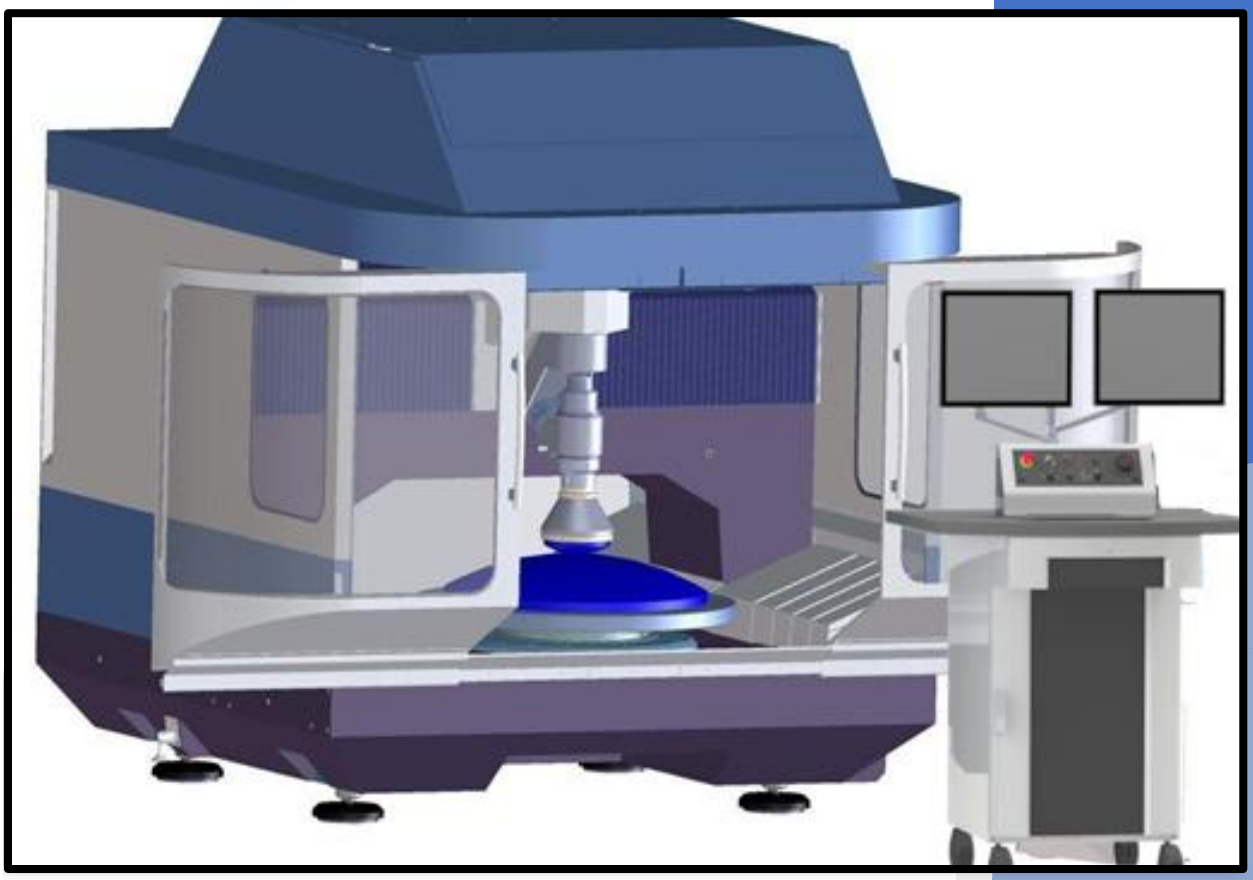
ZEEKO

Utilities & Specification Manual



IRP1200 MK1 Fanuc Ballscrew

Version 3, Rev a

September 2025

Contents

Liability Statement

Zeeko (hereinafter referred to as “the Manufacturer”) warrants that the CNC machines are free from defects in materials and workmanship for a period of one year from the date of delivery. The Manufacturer will repair or replace, at its option, any defective CNC machine or part thereof, provided that the CNC machine is returned to the Manufacturer, or an authorized service engineer site visit is arranged, within the warranty period.

This warranty does not cover normal wear and tear, damage caused by improper installation, operation, maintenance, or modification, or any damage resulting from misuse, abuse, negligence, accident, or natural causes.

The Manufacturer’s liability under this warranty is limited to the repair or replacement of the defective CNC machine or part thereof, and does not include any incidental or consequential damages, such as loss of profits, loss of production, loss of data, or injury to persons or property. The Manufacturer disclaims any implied warranties of merchantability or fitness for a particular purpose, and any other warranties not expressly stated herein.

The Manufacturer is not liable for any direct, indirect, incidental, or consequential damages arising from the use or inability to use the CNC machines, whether based on contract, tort, or any other legal theory, even if the Manufacturer has been advised of the possibility of such damages. The Manufacturer’s maximum liability under any circumstances shall not exceed the purchase price of the CNC machine.

Some jurisdictions do not allow the exclusion or limitation of certain warranties or damages, so some of the above exclusions or limitations may not apply to you. This liability statement gives you specific legal rights, and you may also have other rights that vary from jurisdiction to jurisdiction.

By purchasing, installing, operating, or using the CNC machines, you agree to be bound by the terms and conditions of this liability statement. If you do not agree with this liability statement, do not purchase, install, operate, or use the CNC machines.

Machine description

The IRP1200 machine 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)

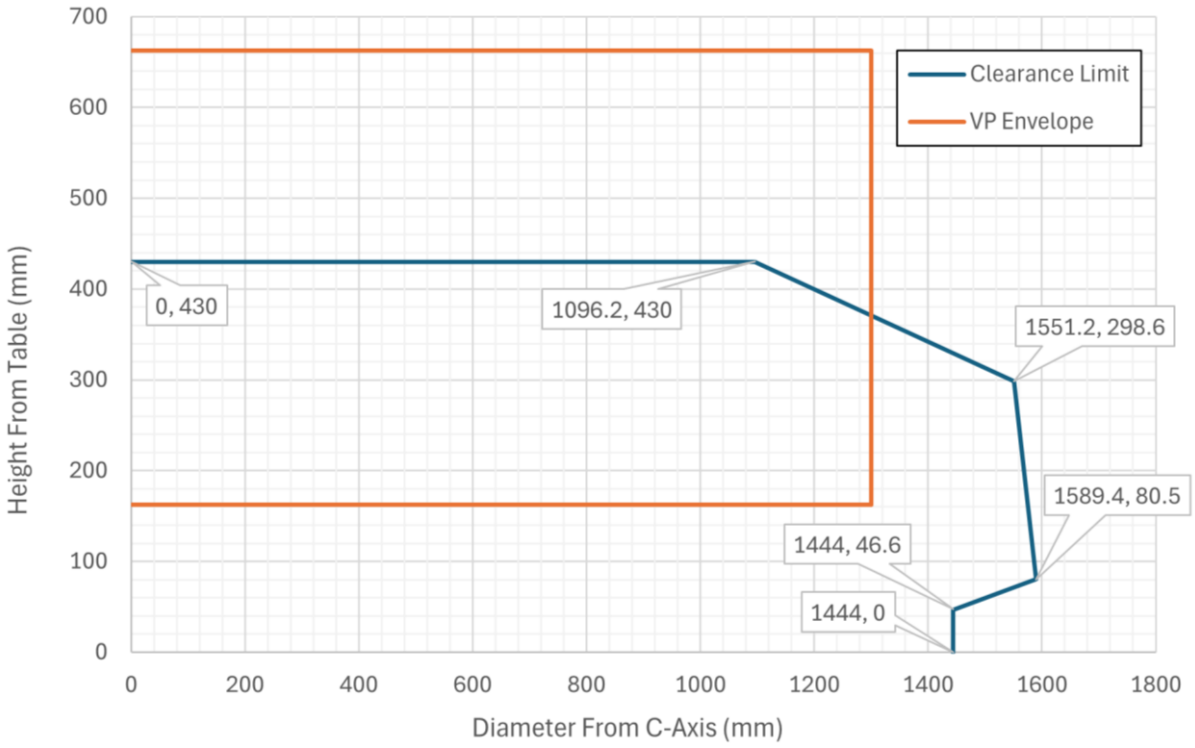
- Size - 2800 mm wide x 3600 mm deep x 3000 mm high
- Mass - 14000 kg

Workpiece size constraints

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

- Polishing Envelope:
  X / Y / Z Travels
  Minimum VP to Table = 178 mm
- Standard Workpiece Size Constraints:
  Parts up to Ø1200 mm and 400 mm height.
  Maximum Mass: 500 kg

  For anything outside of these dimensions please consult Zeeko.
- Dependent on fixturing, part geometry and polishing tool path strategy, heights of 650 mm and Ø 1500 mm may be achievable. Diameters over Ø 1200 mm will be limited to an optical surface slightly less than VP travel (reference part clearance and VP Envelope chart shown below)



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 epoxy-granite base and is aligned perpendicular to the X-axis
- Z is a linear axis which mounts vertically off the X-axis carriage and is aligned perpendicular to both the X and Y axes, normal to the C-axis turntable surface
- C is the work piece rotational axis which is mounted on the base
- The 3-axis assembly (A, B and H) constitutes the virtual pivot assembly which mounts to the Z-axis

Epoxy granite machine base and bridge

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 structural machine elements incorporate the following features:

- 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

Linear axes

Each axis is mounted on a pair of precision 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 linear motion rails
- Travel: X-axis ± 650 mm (total 1300 mm)
- Travel: Y-axis ± 650 mm (total 1300 mm)
- Travel: Z-axis - 495 mm, + 5 mm (total 500 mm)
- Drive system: AC servo driven, caged ball, precision C5 grade or equivalent ballscrew
- Positioning feed-back: Precision absolute linear encoder
- Home position via linear encoder reference mark
- Max velocity: 3000 mm/min

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.

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: ± 270 °
- Max rotational velocity: 10 rpm
- Positional accuracy: ± 1 arcmin

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: ± 180 °
- Max Rotational Velocity: 10 rpm
- Positional accuracy: ± 1.5 arcmin

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 Ø25 mm chuck

- Speed Range: 0, 10 to 2000 RPM
- Polishing Head radius: R20, R40, R80, R160, R320 (optional upgrade kit – includes 40 mm chuck and adapter)

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 DC frameless motor, with positional feedback provided by a precision absolute angle encoder.

The spindle is cooled by an 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 kg [1]
- Vacuum (Optional): 0.8 bar maximum

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

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

Control system - Zeeko Fanuc (30i-B/+) system

- Fanuc Multi-axis Controller, 30i Series CNC
- 30i-B or 30i-B+ Basic unit, Stand-Alone Type
- Number of Axes – 7 axes
- Control Path – 1 Path
- 1 µm Minimum Axis Increment System
- Multi-Axis Spline Capability – AI Contour Control II – NURBS Interpolation
- Remote console and industrial PC with two touchscreens
- Compensation – Straightness, Pitch Error
- Zeeko Dedicated Graphical User Interface
- Ethernet Port for Data I/O and/or Remote Diagnostics / Maintenance
- USB Socket
- Data Server with Compact Flash Card, 16GB
- Program Transfer Tool Software

Covers, guards & 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 doors when the machine is in cycle
  - Electrical cabinet when the machine is energised
- An emergency stop button readily accessible to the machine operator.

Room temperature

- The room temperature must be 20 ºC +/- 1 ºC
- The change in temperature must not exceed 2 ºC per day
- The relative humidity should not exceed 80 %
- If necessary, provide adequate air condition

Electromagnetic Influence

- Interference caused by other electric installations (high frequency) must be avoided.

Electrical specification

Power supply

The machine is designed for operation on 3-phase, 4 wire systems (i.e. 3 Phases + Earth). The machine can accept the following mains voltage stated at the time of order. The standard is:

- 400 v/50/60 *Hz: 3-PE ±5 %.

WARNING: *The machinery must only be plugged into a socket which has a protective earthed conductor. The primary side must match the incoming customer supply voltage. If a supply transformer is required, the secondary voltage supply to the machine must match the machine voltage specification.*

WARNING: *If the mains voltage supply is not the same as that specified on the machine rating plate, the transformer tappings (if applicable) must be interchanged to correspond with the existing mains voltage.* ***This MUST only be performed by qualified personnel.***

Compressed air

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

- Air purges to axes and joints exposed to polishing slurries.
- Linear encoder air purges.
- Bonnet (polishing tool) air pressure.
- Vacuum systems for vacuum work-holding where fitted (chucks).
- Pneumatic systems for the control of fluid systems.

Description	Pressure
Minimum input pressure	6 bar
Maximum input pressure	8 bar
Volumetric requirement	400 l / min (air purges to max.).

NOTE: *Mist separators are fitted internally to all machines.*

Environmental specification

Temperature and humidity

NOTE: *The IRP1200 must be installed inside a room with the following characteristics:*

Temperature and humidity	
Mandatory operating temperature	20 °C +/- 1.0 °C
Maximum operating humidity	75 % RH, non-condensing
Storage temperature	-15 to +50 °C
Maximum storage humidity	80 % non-condensing
Maximum temperature gradient	<2 °C / hour

Cleanliness

The IRP machines do not require sitting in an ISO class clean room. 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.

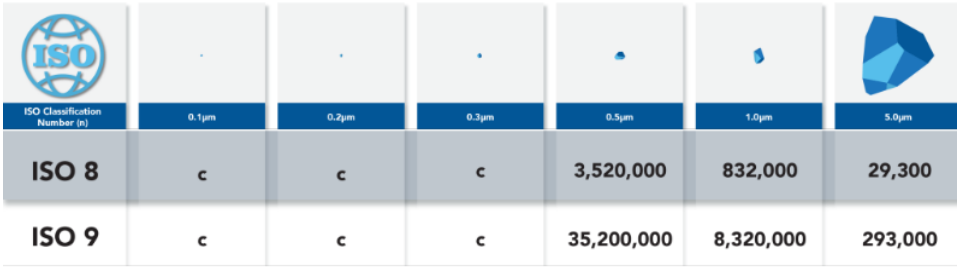
The room should be clean, but not necessarily a clean room as classified by ISO. IRP machines typically use Cerium Oxide slurry as the polishing medium and when this dries on surfaces, it can produce a dust which would be classed as a contaminant in ISO-class cleanrooms.

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 cleanliness protocols will ensure a room that is clean to a very high standard.

NOTE: *A cleanroom classification basically tells you how clean a cleanroom is. While we typically consider cleanrooms to use HEPA filters and multiple layers of protection, cleanrooms can really be any room where precautions are taken to ensure that the product stays clean from contaminants.*

There are 9 ISO classifications of cleanrooms:

- ISO 1
- ISO 2
- ISO 3 (FS 209 E class 1 equivalent)
- ISO 4 (FS 209 E class 10 equivalent)
- ISO 5 (FS 209 E class 100 equivalent)
- ISO 6 (FS 209 E class 1,000 equivalent)
- ISO 7 (FS 209 E class 10,000 equivalent)
- ISO 8 (FS 209 E class 100,000 equivalent)
- ISO 9 (room air)



ISO Classification Number (n)	0.1µm	0.2µm	0.3µm	0.5µm	1.0µm	5.0µm
ISO 8	c	c	c	3,520,000	832,000	29,300
ISO 9	c	c	c	35,200,000	8,320,000	293,000

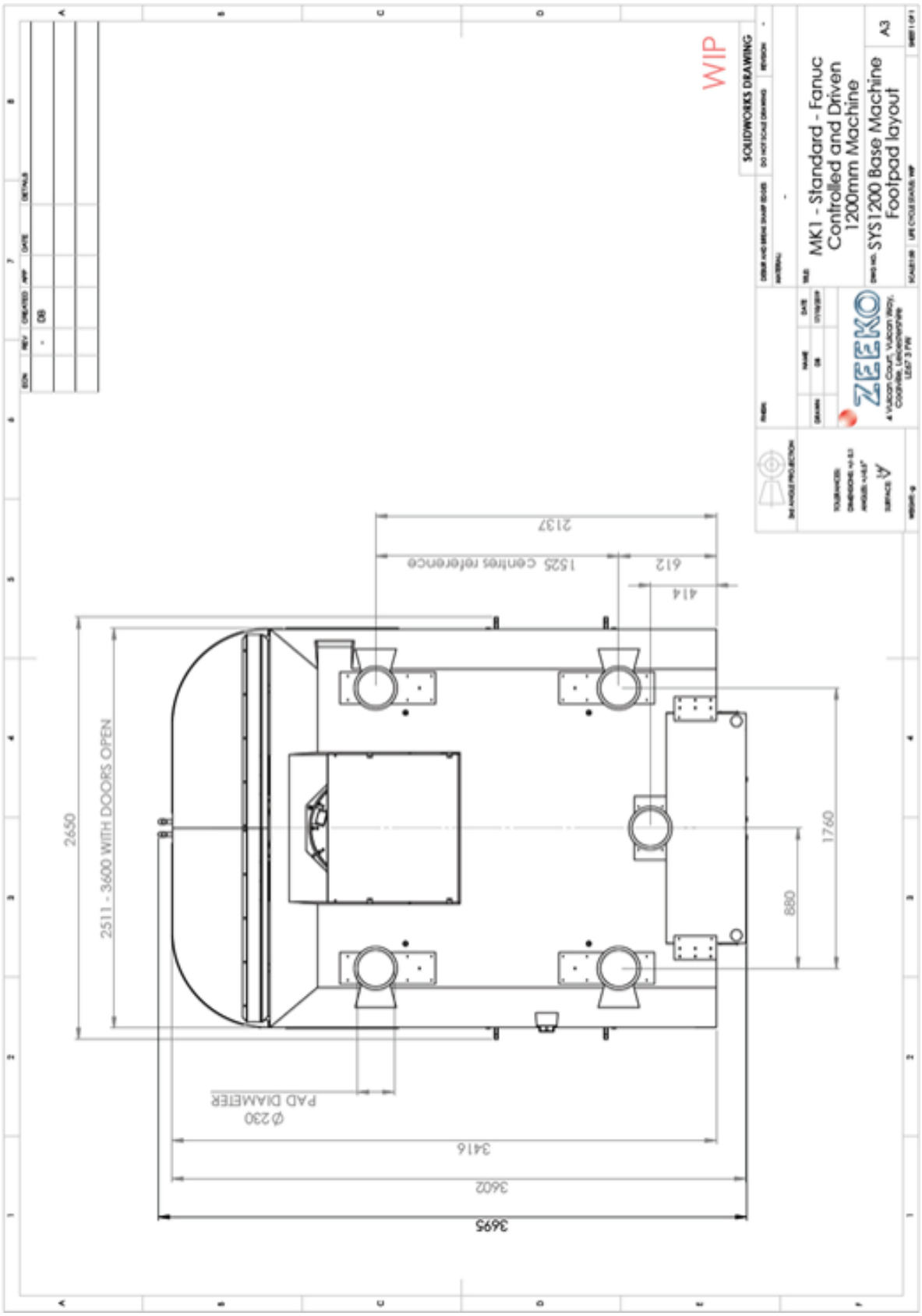
Room vibration requirements

Each IRP machine is equipped with passive vibration isolation feet. The IRP1200 is no different in this respect. To ensure best results, we recommend a vibration environment corresponding to:

- Residential day (ISO) 200 75 barely feelable vibration.

Floor loading

The IRP1200 rests on 5 circular pads with a diameter of 230 mm. The footprint is shown in the diagram below and can be used for planning floor layouts. The mass of the machine is approximately shared equally between the 5 pads of 230 mm diameter. Therefore, the load per foot can be approximated at 13000/5 kg.


WIP
SOLIDWORKS DRAWING
MK1 - Standard - Fanuc
Controlled and Driven
1200mm Machine
SYS1200 Base Machine
Footpad layout
A3
ZEEKO
2137
1525 Centres reference
612
414
2650
2511 - 3600 WITH DOORS OPEN
1760
880
PAD DIAMETER
Ø230
3416
3602
3695

Summary specification

General

General	Description
System Configuration	7-axis CNC Optical Polishing Machine constructed on a Polymer-Granite Machine Base, capable of producing ultra-precise surfaces on a variety of optical materials and surface forms
Workpiece Capacity (1)	Polishing Envelope: X / Y/ Z Travels Minimum VP to Table = 178 mm Workpiece Size Constraints: Parts up to Ø1200 mm and 400 mm height. Maximum Mass: 500 kg For anything outside of these dimensions please consult Zeeko. Dependent on fixturing, part geometry and polishing tool path strategy, heights of 650 mm and Ø 1500 mm may be achievable. Diameters over Ø 1200 mm will be limited to an optical surface slightly less than VP travel (reference part clearance and VP Envelope chart shown on page 4)
Base Structure	Epoxy-Granite
Control System	Fanuc 30i - B / 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/m2 Floor must be even to <3 mm/m2
Environmental Requirements Min/Max Operating Temp. Max Operating Humidity Min/Max Storage Temp. Max Storage Humidity	 20 °C ± 1 °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 ± 5%, 50-60 Hz
Machine Power Rating	27 kW, 39 A
Services Requirements	Clean dry air at 400 litres per minute with a 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

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/sec2	250 mm/sec2	250 mm/sec2
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 100 mm	 <30 µm over full travel <5 µm over 100 mm	 <30 µm over full travel <5 µm over 100 mm
Squareness	<50 µm/m	<50 µm/m	<50 µm/m
Circularity	<50 µm	<50 µm	<50 µm

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	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 [(1)] 75 kg*m2@10 rad/s2
Positional Accuracy	±1 arcmin	±1.5 arcmin	-	±2.5 arcsecs
Working range	±270 °	± 180 °	Continuous bidirectional	Continuous bidirectional
Radial run-out	Rotation of VP Setting ball mounted in H-axis Chuck and rotated about the Virtual Pivot < 20 µm			< 10 µm
Axial run-out				< 40 µm (@R=500)

Contact information

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