



SIP. Société d'Instruments de Précision SA



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Testing certificate No: 1423

Machine type SIP 5000/7
Identification No 4570020

HIGH PRECISION VERTICAL BORING AND MILLING CENTER

Customers name SNECMA, EVRY
CORBEIL
FRANCE

References PH : 07'087

Testing date 22/12/2008.

Traceability The results of measurement indicated are attached to the national standards and thus to achievements recognized at the international level of the units SI.

Place & Date Geneva. 22/12/2008.

Management *Authorized signatures*

Calibration laboratory

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CONTROL REALISED

Metrological characteristics of the axes x. y. z. w. b. c. a & pallets.
Straightness of the axes x. y. z. w.
Perpendicularity of the axes x-z. y-z. x-y.
Spindle rotation axis square to the axes x and y.
Geometrical characteristics table. of rotary table(s) & pallets.
Run out of the spindle.
Accessories test.

TESTING CONDITIONS

2.1 Definition of the metrological characteristics

The tolerances of positioning accuracy over the entire travel of the axis correspond to the following definitions:

According to the recommendation of "VDI/DGQ 3441". the values correspond to the positional uncertainty "P". Bi-directional measurements at 18 positions minimum equally spaced over the entire travel of the axes and repeated 5 times.

The tolerances of scatter of positioning of axis correspond to the following definitions:

According to the recommendation of "VDI/DGQ 3441". the values correspond to the characteristics Ps which is Ps mean.

The tolerances of reversing error of the axis correspond to the following definitions:

According to the recommendation of "VDI/DGQ 3441". The values correspond to the "average reversal error U". which is U mean.

2.2 Calibration of the machine (traceability)

Concerning the scatter and non-linearity of positions for the axes (irregularities of subdivisions) with the help of a laser interferometer.

For practical reasons. the calibration is performed under the following conditions:

For axis X. in the centre of the table and at 100 mm above the table surface.

For axis Y. at 100 mm above the table surface.

For axis Z. within the spindle axis.

2.3 Workshop

The following reference conditions must be observed:

Temperature:

- a) Recommended temperature to be selected between:
- b) Non-homogeneity within the machine volume:
- c) Tolerated variations of a) and b):
- d) Equal temperature between the machine and the part to be machined:
- e) Relative humidity:

References

+ 18 and + 24 °C

0.5 °C

0.5 °C/h - 2°C / 24 h

25 % - 75 %



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2.4 Measurement units

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1 m	39.3700 in
1 mm	0.04 in
1 μ m	0.001 mm
1 μ m	40 μ in
1 μ m	0.00004 in
0.1 μ m	4 μ in
0.1 μ m	0.000004 in

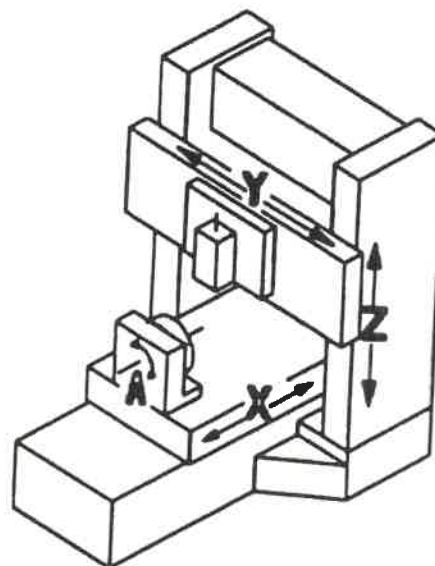
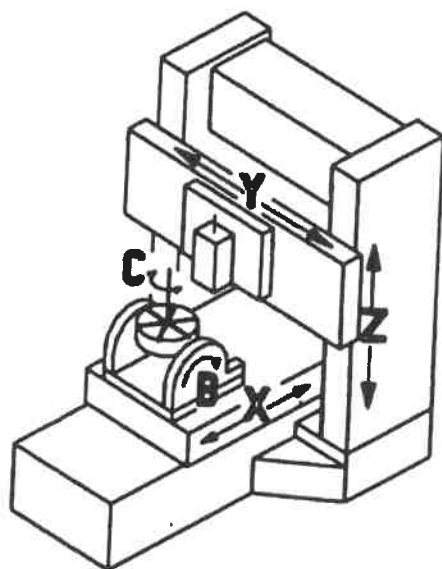
L
°C/K
1 °C/K
20 °C
h
1 sec.

measured length in m
degree Celsius/ Kelvin
1.8°F (degree Fahrenheit)
68°F (degree Fahrenheit)
Hour
1 second of arc

3 DOCUMENTATION

The testing and calibration procedures as well as the pertinent documents are on record at SIP.

4 AXES DEFINITION



**5. METROLOGICAL CHARACTERISTICS**

Positioning accuracy (uncertainty) over the entire linear and circular travel of the axis		
Position	Measured values	Tolerance values
Axis X	2.0 μm	3.0 μm
Axis Y	2.5 μm	3.0 μm
Axis Z	2.6 μm	3.0 μm
Axis C	1.3 sec	3.0 sec

Scatter of positioning of the axis		
Position	Measured values	Tolerance values
Axis X	0.7 μm	1.5 μm
Axis Y	1.2 μm	1.5 μm
Axis Z	1.2 μm	1.5 μm
Axis C	0.4 sec	1.5 sec

Reversing error of the axis		
Position	Measured values	Tolerance values
Axis X	0.3 μm	0.5 μm
Axis Y	0.3 μm	0.5 μm
Axis Z	0.4 μm	0.5 μm
Axis C	0.2 sec	0.5 sec

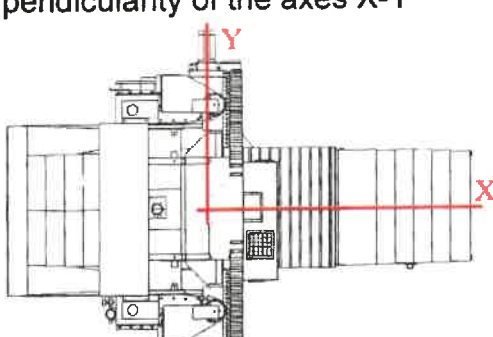
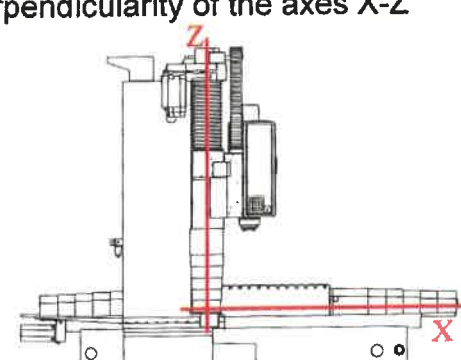
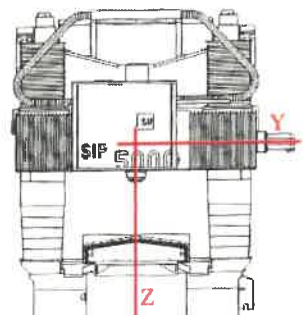
**6. STRAIGHTNESS OF THE AXES X. Y. Z. W**

Straightness of the axis X		
Position	Measured values	Tolerance values
Range of rotations around the axis X	1.0 sec.	2.5 sec.
Range of rotations around the axis Y	1.5 sec.	2.5 sec.
Range of rotations around the axis Z	1.6 sec.	2.5 sec.

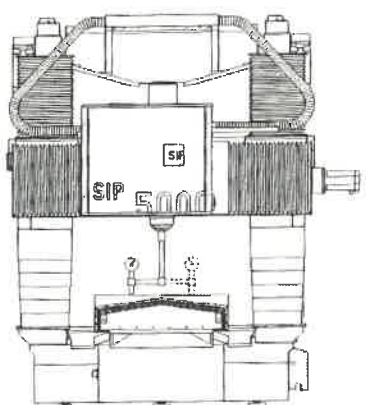
Straightness of the axis Y		
Position	Measured values	Tolerance values
Range of rotations around the axis X	1.2 sec.	2.5 sec.
Range of rotations around the axis Y	1.9 sec.	2.5 sec.
Range of rotations around the axis Z	1.6 sec.	2.5 sec.

Straightness of the axis Z		
Position	Measured values	Tolerance values
Range of rotations around the axis X	2.2 sec.	2.5 sec.
Range of rotations around the axis Y	0.4 sec.	2.5 sec.

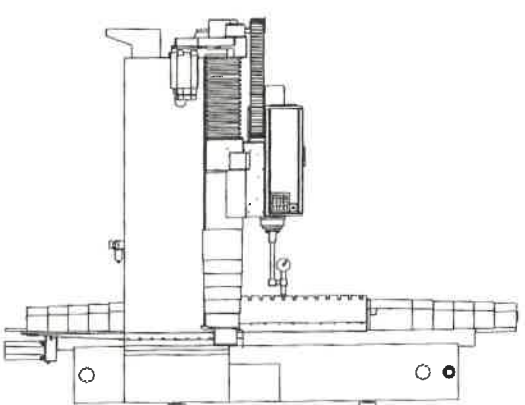
7. PERPENDICULARITY OF THE AXES X-Z. Y-Z. X-Y

Position	Measured values	Tolerance values
Perpendicularity of the axes X-Y  L = 600 mm	23/11/2020 7 μ 1.0 μm	5.0 μm
Perpendicularity of the axes X-Z  L = 600 mm	23/11/2020 MP/600 0.5 μm	5.0 μm
Perpendicularity of the axes Z-Y  L = 600 mm	23/11/2020 4 μ/600 0.5 μm	5.0 μm

8. SPINDLE ROTATION AXIS SQUARE TO THE AXES X AND Y

Position	Measured values	Tolerance values
 Ø 300 mm	3.0 µm	4.0 µm

9. GEOMETRIC CHARACTERISTICS OF TABLE SURFACE. ROTARY TABLE AND PALLETS

Table surface parallel to the axes Y & X		
Position	Measured values	Tolerance values
 (*)1600 X 1100 mm	<u>23/11/2020</u> 5 µm 6.0 µm	6.0 µm

(*) According to machine.



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11. RUNOUT OF THE SPINDLE

Spindle / and Proving bar - ISO		
Title	Measured values	Tolerance values
Spindle ISO	<i>23/11/2020</i> <i>A: < 1 μ</i> <i>C: 5 μ</i> A : 0.6 μm B : 1.4 μm C : 2.4 μm	A : 2.0 μm B : 2.5 μm C : 3.0 μm
(SIP Roundness testing conditions: 100 rpm)		

12. PIBOMULTI Accessories

Head No 280131/1		
Position	Measured values	Tolerance values
Parallelism to axes X-Z, L = 25 mm	4.0 μm	10.0 μm
Parallelism to axes X-Y, L = 25 mm	3.0 μm	10.0 μm

Head No 280131/2		
Position	Measured values	Tolerance values
Parallelism to axes X-Z, L = 25 mm	6.0 μm	10.0 μm
Parallelism to axes X-Y, L = 25 mm	3.0 μm	10.0 μm