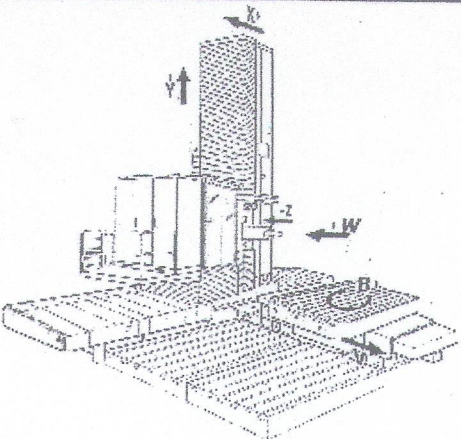


CERTIFICATE GEOMETRIC ACCURACY OF HORIZONTAL BORING MILLS IN A PLATE VERSION

Producer: SCHARMANN	
Type of machine:	Bover
Production number:	332 046
Year of production:	1979
Machine configuration:	X : 8000 Y : 3000 Z : W : V :
	
Customer: Litastroj	

Number of measured positions :
horizontal boring mill:
with table:
with work-holding fixed tables

General requirements

- ✓ The supplied machine must be fixed to a base recommended by The manufacturer and levelled horizontally in order to receive a statically stable position.
- ✓ The supplied machine and measuring instruments must be protected against draught and disturbing heat radiation.
- ✓ The environmental temperature range, within which the specified accuracy can still be achieved is $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$
- ✓ Any temperature changes during the twelve hours prior to the measurements being taken must not exceed 2°C (either as a temperature increase or decrease).
- ✓ Temperature changes in environments, which are at a height of 5000 mm, must not be greater than 2°C .

Gauges used:

Electronic level NT 11/W 0,001/1000; measuring square ; measuring bridge ; gauge mandrel- 300mm; dial gauge 0,01mm, 0,001 mm ; EMA perpendicularity gauge.

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Representative of customer

At: Litastroj, Lj

Handed over positions

Unless otherwise stated, the measurement should be carried out based on ISO international standards (G ... position) :

- ✓ ISO 230-1:1996; Test code for machine tools – Part1: Geometric accuracy of machines operating under no-load or finishing conditions.

ISO 3070-2,3 :2007 Test conditions for boring and milling machines with horizontal spindle - Testing of the accuracy

Part 2: Floor type machines

Part 3: Planer type machines with movable column.

- ✓ Representation of the measurement positions is schematic and shows one of possible ways of measurement. For the handing over procedure at the customer site, the manufacturer / supplier can also utilise the equivalent method of measurement.
- ✓ The ordering of measurement positions in this protocol does not have to determine the test ordering when in progress.
- ✓ If the measurement equipment allows so, the customer should obtain also the electronic version of evaluation of measurement results.

LIST OF TRANSFER POSITIONS MEASUREMENTBORING MILLS

1. (G3) Straightness of the column movement (X-axis) in vertical plane XY
2. (G4) Angular deviations of the column movement (X-axis)
3. (G5) Straightness of the spindle head movement (Y-axis) in the YX, YZ plane
4. (G6) Angular deviations of the spindle head movement (Y-axis) in the YZ-plane
5. (G8a) Squareness of the spindle head movement (Y-axis) to the the column movement (X-axis)
6. (G13) Periodic axial slip, spindle retracted
7. (G13) Spindle radial runout a) spindle retracted b) checkpoint at 300 mm
8. (G13) Spindle taper runout a) next to spindle face b) at 300 mm from the spindle face
9. (G18) a) Radial b) Axial run-out of the milling spindle nose
10. (G15) Squareness of the spindle axis (W axis) to the column movement (X-axis).
11. (G16) Squareness of the spindle axis (W axis) to the spindle head movement (Y- axis)
12. (G17b) Squareness of the boring spindle movement (W axis) to the spindle head movement (Y-axis) spindle out 2D,4D
13. (G20) Squareness of the ram movement (Z-axis) to the column movement (X-axis)
14. (G21) Squareness of the ram movement (Z-axis) to the spindle head movement (Y-axis)

with table

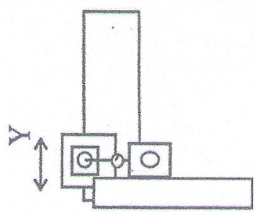
- 1.S (G3) Straightness of the table movement (V-axis) In the YZ-plane (vertical plane)
- 2.S (G4) Angular deviations of the table movement (V-axis) a) in the YZ-plane (vertical plane -pitch) ; in the XY-plane (vertical plane -roll)
- 3.S Table surface level during rotation a) lengthwise b) crosswise
- 4.S (G7) Squareness of the column movement (X-axis) to the table movement (V-axis)
- 5.S (G8) Squareness of the spindle head movement (Y-axis) to the table movement (V-axis)
- 6.S Flatness of the table surface along the clamping slots ;across the clamping slots
- 7.S (G10) Parallelism of the table surface to:a) the table movement (V-axis) b) the column movement (X-axis)
- 8.S (G12) Rotary table surface axial runout
- 9.S (G13) Run-out of the centring hole of the table in relation to axis of rotation
- 10.S (G11) Middle "T" slot parallel alignment accuracy to both Transverse and Longitudinal movement
- 11.S (G16) Parallelism of the boring spindle axis to the table movement (V- axis)

With work-holding fixed tables

- 1.D Flatness of the work-holding fixed table surface
- 2.D Parallelism of the first "T" slot of the work-holding fixed table with the column movement

DEVIATION ACTUAL [mm]

5. Squareness of the spindle head movement (Y-axis) to the the column movement (X-axis)

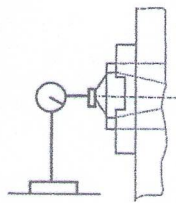


DEVIATION ACCEPTABLE [mm]
0,03 / *1000

* The deviation can be evaluated also using the different measurement length.

customer:
YX: 0,01 / 500

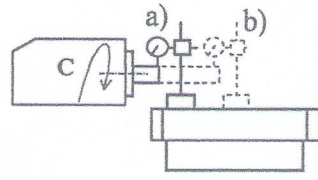
6.
Periodic axial slip, spindle retracted



0,01

7.
Spindle radial runout

a) spindle retracted
b) checkpoint at 300 mm

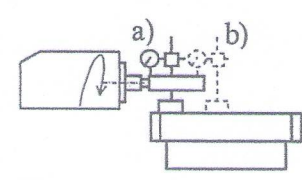


DEVIATION ACCEPTABLE [mm]

**a) 0,01
b) 0,02**

8.
Spindle taper runout

a) next to spindle face
b) at 300 mm from the spindle face
(for both 0 and 180 mandrel positions)



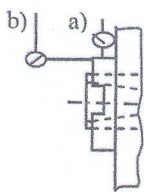
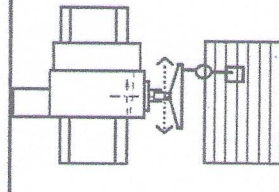
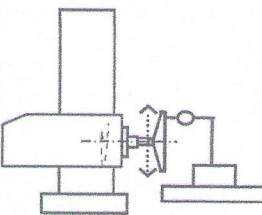
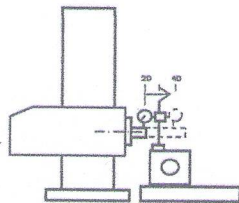
**a) 0,01
b) 0,02**

customer

a) : 0,015
b) : 0,06

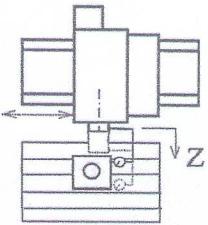
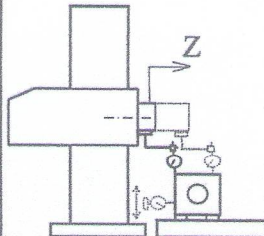
a) 0°	180°:
b) 0°	180°:

DEVIATION ACTUAL [mm]

<p>9. Run-out of the milling spindle no. a) radial run-out b) axial run-out</p>  <p>a) 0,015 b) 0,02</p>	<p>10. Squareness of the W -axis to X-axis.</p>  <p style="text-align: center;">DEVIATION ACCEPTABLE [mm]</p> <p>0,015/500</p>	<p>11. Squareness of the W -axis to Y-axis.</p>  <p style="text-align: center;">DEVIATION ACCEPTABLE [mm]</p> <p>0,015/500 up</p>	<p>12. Squareness of the boring spindle movement (W-axis) to the spindle head movement (Y-axis) spindle out 2D,4D</p>  <p>2D: + 0,015 (up) 4D: ± 0,02 ; 6D: - 0,06</p>
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customer note the position No.9a) in the original protocol was incorrectly referred tolerance value of 0.01

<p>a) : 0,03 b) : 0,005</p>	<p>0,06 / 500</p>	<p>0,01 / 500</p>	<p>2D : 4D (500) :</p>
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<p>13. Squareness of the ram movement (Z-axis) to the column movement (X-axis)</p>  <p style="text-align: center;">DEVIATION ACCEPTABLE [mm]</p> <p>0,03/500</p>	<p>14. Squareness of the ram movement (Z-axis) to the spindle head movement (Y-axis)</p> 
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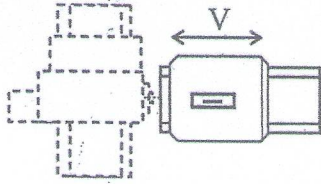
Customer

<p>0,02 / 500</p>	<p>0,03 / 500</p>
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Measured positions with table S25-0507

DEVIATION ACTUAL [mm]

1.S Straightness of the table movement (V-axis) in the YZ-plane (vertical plane)



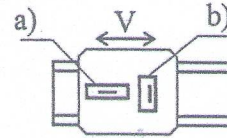
DEVIATION ACCEPTABLE [mm]

0,02/1000

Add 0,01 to the preceding tolerance for each 1000 increase in length beyond 1000 max. 0,03

2.S Angular deviations of the table movement (V-axis)

- a) in the YZ-plane (vertical plane -pitch)
- b) in the XY-plane (vertical plane -roll)



0,04 /1000

customer

plane YZ: **0,02** /2500

a) YZ: max. **0,03** /1000

b) XY: max. **0,03** /1000

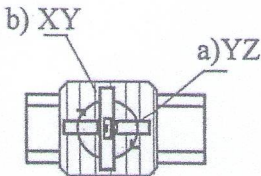
plane YZ: Measuring angular deviations steplength 200 mm [µm/m]

	0	1	2	3	4	5	6	7	8	9	10
customer	0										

plane XY:

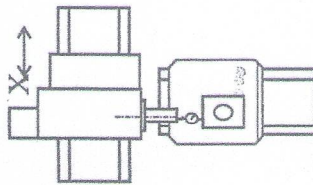
	0	1	2	3	4	5	6	7	8	9	10
customer	0										

3.S Table surface level during rotation a) lengthwise b) crosswise



0,02/1000

4.S Squareness of the column movement (X-axis) to the table movement (V-axis)

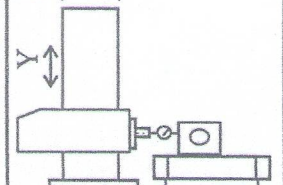


DEVIATION ACCEPTABLE [mm]

0,03/ *1000

* The deviation can be evaluated also using the different measurement length.

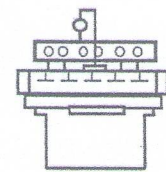
5.S Squareness of the spindle head movement (Y-axis) to the table mov. (V-axis)



DEVIATION ACCEPTABLE [mm]

0,03/ ~~1000~~

6.S Flatness of the table surface along the clamping slots (flat to concave)



0,03/1000

Add 0,01 to the preceding tol. for each 1000 increase in length beyond 1000. Max. 0,06

customer

a): **0,02 / 1000**
b): **0,07 / 1000**

0,03 / ~~1000~~
1000

0,03 / ~~1000~~
1000

along the clamping slots:

across the clamping slots:

DEVIATION ACTUAL [mm]

7.S
 Parallelism of the table surface to: a) the table movement (V-axis) b) the column movement (X-axis)

0,04/1000

Add 0,01 to the preceding tol. for each 1000 increase in length beyond 1000. Max. 0,06mm

a) 0,01 | b) 0,015

8.S
 Rotary table surface axial runout

DEVIATION ACCEPTABLE [mm]

0,04 /R
(R=1000)

0,03 /R

9.S
 Run-out of the centring hole of the table in relation to axis of rotation

0,015

Customer

0°	90°	0°	90°		
180°	270°	180°	270°		

10.S Middle "T" slot parallel alignment accuracy to both a) Transverse and b) Longitudinal movement

DEVIATION ACCEPTABLE [mm]

0,02/1000

11.S Parallelism of the boring spindle axis to the table movement (V- axis)
 a) in the YZ-plane (vertical)
 b) in the XZ-plane (horizontal)

0,02 /300

customer

0° :	90° :	a) YZ: 0,01 /300	
180° :	270° :	b) ZX: 0,01 /300	