

JIS

JAPANESE INDUSTRIAL STANDARD

**Test Code for Performance and
Accuracy of Numerically
Controlled Horizontal Boring
Machines (Table Type)**

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Test Code for Performance and Accuracy of
Numerically Controlled Horizontal Boring
Machines (Table Type)

B 6334-1986

1. Scope

This Japanese Industrial Standard specifies the test code for operation performance, rigidity, mechanical accuracy and working accuracy of numerically controlled horizontal boring machines (table type) of not more than 130 mm in main spindle diameter.

Remark: In this standard the units given in { } are conventional units and are appended for reference.

2. Operation Test Methods2.1 Function Test

2.1.1 Function Test not According to Numerical Control The function test not according to numerical control shall be carried out in accordance with Table 1 by operating each part manually.

Applicable Standards:

JIS B 4105-Shingle Point Tools with Cemented Carbide Tips

JIS B 4114-Parallel Shank End Mills Brazed with Cemented Carbide
Tips

JIS B 4212-End Mills with Taper Shanks

JIS B 6003-Methods of Vibration Testing for Machine Tools

JIS B 6004-Method of Sound Level Measurement for Machine Tools

JIS B 6014-General Code of Safety for Machine Tools

JIS B 6201-Test Code for Performance and Accuracy of Machine Tools

JIS B 6330-Test Code for Performance and Accuracy of Numerically
Controlled Tools

JIS G 5501-Gray Iron Castings

Table 1

No.	Test item	Test method	Reference Corresponding No. of 3.2 in JIS B 6201 and 3.2.1 in JIS B 6330
1	Starting, stopping and working operation of main spindle and milling spindle ⁽¹⁾	Carry out starting and stopping (including inching and braking) on positive revolution and reverse revolution at an adequate spindle speed continuously 10 times to test the smoothness and security of working.	1-11
2	Conversion operation of main spindle and milling spindle ⁽¹⁾	Convert the spindle speed concerning the all marked speeds ⁽²⁾ to test the smoothness of working and the security of indication.	1-12
3	Starting of feed, stopping and working operation	Concerning respectively main spindle, spindle head, table and swivelling table, carry out starting and stopping (including inching) at an adequate feed speed (or feed rate) continuously 10 times to test the smoothness and security of working.	1-21
4	Conversion operation of feed speed (or feed rate)	Concerning three feeds of respective marked lowest ⁽³⁾ , middle and highest ⁽³⁾ of main spindle, spindle head, table and swivelling table, convert the feed speed (or feed rate) to test the smoothness of working and the security of indication.	1-22 1-23
5	Operation of hand-feed	Travel manually the main spindle, spindle head, table and swivelling table respectively, to test the smoothness and uniformity of working over the whole length of movement. Furthermore, test the security of function of micrometer collar.	1-27
6	Putting on and off of power feed and quick traverse and operation of the devices	Concerning main spindle, spindle head, table and swivelling table respectively, test the smoothness and security of setting of positions of putting on and off of power feed and quick traverse and of working.	1-21 1-31

Table 1 (Continued)

No.	Test item	Test method	Reference Corresponding No. of 3.2 in JIS B 6201 and 3.2.1 in JIS B 6330
7	Operation of automatic stopping device	Concerning the main spindle, spindle head, table and swivelling table respectively, test the smoothness and security of setting the command position of automatic stopping device and of working.	1-26 1-32
8	Operation of clamping	Concerning each clamping machine of main spindle, spindle head, table and swivelling table, clamp at an arbitrary position of respective movements to test the security.	1-33
9	Operation ⁽⁴⁾ of attaching and detaching of tools	Test the security and smoothness of attaching and detaching of tools	1-41
10	Electric device	Before and after operation test, test the insulation condition once respectively. However, this specification does not apply to the circuit using semiconductor or the like.	1-51
11	Numerically controlled device	Test the smoothness of working and the security of function of each display lamp, tape reader, fan, etc. of numerically controlled device.	1-57
12	Safety device	Test the safety for operator and the security of machine protective function ⁽⁵⁾ [See JIS B 6014].	1-52
13	Lubricating device	Test the security of function such as oil tightness, suitable distribution of oil amount, etc.	1-53
14	Oil hydraulic and pneumatic device	Test the security of function of oil tightness, gas tightness, pressure regulation, etc.	1-54
15	Attachments	Test the security of function.	1-55

- Notes (1) Carry out this operation on the milling spindle driven separately from the main spindle.
- (2) In the case of infinite variable speed drive, carry out on three speeds of the minimum, medium and maximum speeds.
- (3) In the case of feed rate, these are read as the minimum and the maximum instead of these.
- (4) The operation includes the attaching and detaching shank to the spindle taper hole.
- (5) For example, it means the travel limit automatic stopping function of each motion spindle, the emergency stopping function in case where the synchronization of control system is lost or overheating or overload of electric motor for main spindle is generated, etc.

2.1.2 Function Test According to Numerical Control The function test according to numerical control shall be carried out according to Table 2 with actuating each part by numerical control tape for test and other numerical control command⁽⁶⁾.

Table 2

No.	Test item	Test method	Reference Corresponding No. of 3.2 in JIS B 6201 and 3.2.2 in JIS B 6330
1	Starting, stopping and reversing of main spindle and milling spindle ⁽¹⁾ and conversion of spindle speed	Rotate main spindle and milling spindle ⁽¹⁾ , carry out conversion of spindle speed concerning starting, stopping, reversing and all marked speeds ⁽²⁾ to test the security of function and the smoothness of working.	1-13 1-14
2	Starting and stopping of feed and conversion of feed speed	Convert the feed speed to at least three feed speeds of the marked lowest, medium and highest and quick traverse, carry out starting and stopping on positive and negative of each feed to test the security of function and the smoothness of working. Carry out this test on each control spindle.	1-28
3	Dividing of swivelling table	Carry out dividing of swivelling table to test the security of function and the smoothness of working.	1-34
4	Inching	Carry out inching operation on each control spindle to test the security of function and the smoothness of working.	—
5	Returning to original point	Carry out returning to original point ⁽⁷⁾ from an arbitrary position capable of returning on each control spindle to test the security of function and the smoothness of working.	1-35
6	Other functions	Concerning other functions to be provided respectively to test the security of function and the smoothness of working.	1-61

Notes ⁽⁶⁾ Other numerical control commands contain the numerical control commands according to input by card, online, manual data input device and according to manual input by push button on operating board.

⁽⁷⁾ Travelling or rotation shall, as a rule, be quick traverse, its amount shall be not less than the distance or the angle including the automatic acceleration and deceleration.

Remark: The test may be carried out at the same time as the continuous no-load operation test.

2.2 No-Load Operation Test For the no-load operation test, operate main spindle and milling spindle⁽¹⁾ with starting from the lowest speed at each stage and successively continue the operation at the highest speed, as a rule, for 30 to 60 min to measure each item specified in Table 3 Recording Form 1-1 [See 3.3 of JIS B 6330].

Further, after operating at the highest speed, operate the main spindle at an adequate speed, take the feed speed (or feed rate) at the lowest⁽³⁾, medium, highest⁽³⁾ and quick traverse and concerning those respectively measure each item specified in Table 4 Recording Form 1-2.

Furthermore, observe the vibration and noise. In the case where the vibration and noise are put particularly in question the test shall be in accordance with JIS B 6003 and JIS B 6004.

Table 3. Recording Form 1-1

No.	Measuring time h·min	Main spindle or milling spindle speed min ⁻¹ {rpm}		Temperature °C			Required electric power (power source frequency Hz)			Description
		Mark	Actual measurement	Main bearing		Room temperature	Voltage V	Current A	Input kW	
				Front	Rear					

Table 4. Recording Form 1-2

Measuring item Feed speed		Feed speed ⁽⁸⁾ in X-axis direction of table mm/min		Feed speed ⁽⁸⁾ in Y-axis direction of spindle head mm/min		Feed speed ⁽⁸⁾ in Z-axis direction of table mm/min		Feed speed ⁽⁸⁾ in W-axis direction of main spindle mm/min		Swivelling speed of swivelling table spindle B by numerical command Degree/min		Description
		Command	Actual measurement	Command	Actual measurement ⁽⁹⁾	Command	Actual measurement	Command	Actual measurement	Command	Actual measurement	
Lowest												
Medium	Without override											
	With override ⁽¹⁰⁾											
Highest												
Quick traverse												

Notes ⁽⁸⁾ The machine marked with the feed rate shall be tested according to the feed rate, and the effect shall be recorded in the description column.

⁽⁹⁾ The speed and the direction(±) shall be recorded.

⁽¹⁰⁾ Where the feed-speed override function is actuated, the override rate (%) shall be recorded in the command column.

2.3 Continuous No-Load Operation Test For the continuous no-load operation test, carry out a continuous operation of about 2 h⁽¹¹⁾ according to the test tape including each type function or the other numerical control command⁽⁶⁾ to test the existence of abnormalities (see 3.4 of JIS B 6330).

In this case, the test tape or other numerical control command shall contain at least the following contents:

- (1) Concerning the marked medium spindle speed⁽¹²⁾, positive revolution, reversing, starting and stopping.
- (2) The feed speeds shall be marked lowest, medium, highest and quick traverse on each spindle. The travel distance shall be approximately the marked whole range and each spindle includes the quick traverse of not less than 1/2 of the travel distance.
- (3) Positioning⁽¹³⁾ of each spindle at an adequate position approximately over the whole range of the travel distance.
- (4) Automatic dividing of swivelling table.

Notes ⁽¹¹⁾ The operation shall be continuous operation of not less than two cycles.

⁽¹²⁾ For the machine having automatic conversion function of spindle speed, not less than 5 speeds including the lowest, medium and highest shall be included.

⁽¹³⁾ The machine provided with control function of not less than two spindles shall include this.

Remark: On the table, there shall be no load.

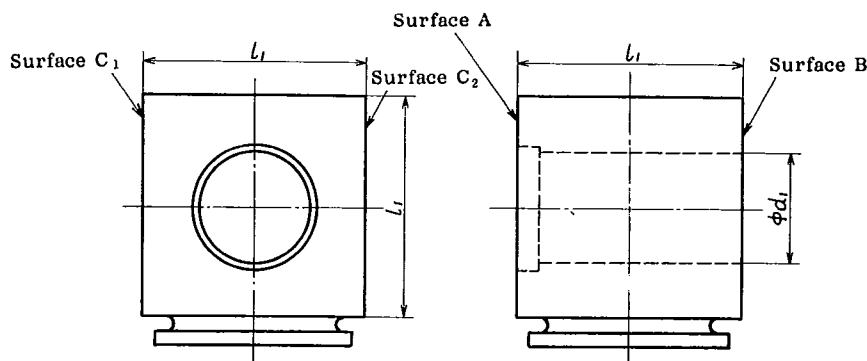
2.4 Loading Operation Test For the loading operation test, carry out the chatter test (boring by main spindle and milling by main spindle) and cutting power test (milling by milling spindle) to measure the required electric power.

Further, observe the vibration, noise and condition of finished surface (see 3.4 of JIS B 6201). Where the vibration and noise are put particularly in question, it shall be in accordance with JIS B 6003 and JIS B 6004.

Works shall be as shown in Fig. 1 and cuttings be all dry type cuttings.

Fig. 1

Unit: mm



Main spindle diameter (D)	(l_1)	(d_1)	Material
90 max.	About $4 D$	About $1.3 D$	To be, as a rule, FC 20 specified in JIS G 5501.
Exceeding 90 up to and including 130			

2.4.1 Chatter Test The chatter test means the test for stability of cutting. Carry out boring by main spindle and milling by main spindle under the following conditions to observe the chatter condition (see No. 3-14 of 3.4 of JIS B 6201).

Carry out this test until chatter is generated by increasing the feed. However, when the electric motor for main spindle has reached the specified power before chatter is generated, stop at that feed.

- (1) **Boring by Main Spindle** It shall be overhung cutting by main spindle and carry out boring by spindle feed under the following conditions (see Table 5 Recording Form 2).

Table 5. Recording Form 2

Material of work		Cutting conditions						Delivery amount of main spindle ⁽¹⁴⁾		Required electric power (power source frequency Hz)					Chatter condition	Description
No.	Spindle speed (n) min ⁻¹ {rpm}	Cutting speed (V_c) m/min	Cutting depth (a) mm	Feed rate (S) per one revolution mm	Feed speed (V_f) mm/min	Cutting area ($a \cdot S$) mm ²	Type shape, etc. of tool	Starting of. cutting mm	Comple- tion of cutting mm	Voltage V	Current A	Load input (W) kW	No-load input (W_0) kW	Cutting power ($W - W_0$) kW		

Note (¹⁴) The amount of delivery of main spindle means the distance from the milling spindle end face to the blade tip.

(a) Tool The tool shall, as a rule, be Type 31 or Type 32 specified in JIS B 4105.

(b) Cutting Condition

Cutting speed: $V_c = 50$ to 80 (m/min)

Cutting depth: $a \approx \frac{D}{25}$ (mm)

Boring diameter: $d = 1.4 D$ to $2 D$ (mm)

Feed rate: $S \approx \frac{D}{400}$ to $\frac{D}{160}$ (mm per one revolution)

where D : main spindle diameter (mm)

Feed speed: $V_f = S \times n$ (mm/min)

(c) Cutting method Carry out boring of d_1 hole of the work by delivery of main spindle. Make the distance from the opposite surface of the work to the milling spindle end surface $2D$ and cutting final position, about $4 D$.

(2) Milling by Main Spindle Carry out milling by the main spindle under the following conditions (see Table 6 Recording Form 3).

Table 6. Recording Form 3

Material of work				Diameter of tool				Number of blade							
No.	Cutting conditions							Type, shape, etc. of tool	(14) De- livery amount of main spindle mm	Required electric power (power source frequency Hz)				Chatter condition	Description
	Spindle speed (n) min^{-1} (rpm)	Cutting speed (V_c) m/min	Cutting depth (a) mm	Feed speed (V_f) mm/min	Feed per one blade (S_z) mm	Cutting width (b) mm	Cutting amount cm^3/min			Voltage V	Current A	Load input (W) kW	No-load input (W_0) kW		

(a) Tool The tool shall, as a rule, be cemented carbide front face milling cutter, its diameter shall be in accordance with Table 7, and the required items be recorded according to Table 8 Recording Form 4.

Table 7

Main spindle diameter	Milling cutter diameter (approx.) mm
90 max.	100 to 200
Exceeding 90 up to and including 130	150 to 250