

JIS

JAPANESE INDUSTRIAL STANDARD

**Test Code for Performance
and Accuracy of Machining
Centers (Vertical Type)**

JIS B 6338—1985

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Test Code for Performance and Accuracy
of Machining Centers (Vertical Type)

B 6338-1985

1. Scope

This Japanese Industrial Standard specifies the methods of running test and accuracy inspection of machining centres (vertical type) of the vertical monoaxial type having automatic tool replacing devices (including the turret type) and whose maximum travelling distance in the control axis direction is within 2000 mm.

Remark: The units and numerical values given in { } in this standard are in accordance with the gravitational system of units and are appended for reference.

2. Method of Running Test2.1 Function Test

2.1.1 Function Test without Use of Numerical Control The function test of machining centres (vertical type) without use of numerical control shall be performed by operating the respective parts manually and according to the conditions specified in Table 1.

Table 1

No.	Test item	Test method	Reference Corresponding number in 3.2 of JIS B 6201 and in 3.2.1 of JIS B 6330
1	Start, stop, and running operations of main spindle ⁽¹⁾	Examine the smoothness and reliability of operation by performing start and stop [including inching ⁽¹⁾ and braking ⁽¹⁾] continuously 10 times at a suitable main spindle speed and for regular rotation and reverse rotation.	1-11
2	Changing operation for main spindle speed ⁽¹⁾	Examine the smoothness of operation and the reliability of indication of the operating device by changing the main spindle speed to three indicated speeds-lowest, intermediate, and highest.	1-12
3	Indexing of rotating table ⁽²⁾	Perform indexing of the rotating table and examine the smoothness and reliability of operation.	1-33
4	Clamping operation ⁽¹⁾	Examine the reliability of the respective clamping functions of the main spindle, spindle head, column, table, rotating table, and the like by clamping at an arbitrary position of their travelling ranges.	1-33
5	Attachment and detachment of tool ⁽¹⁾	Examine the reliability and smoothness of attachment and detachment of the tool to and from the main spindle and tool magazine.	1-41
6	Electric devices	Examine the insulation condition each one time before and after the running test.	1-51
7	Numerical control device	Examine the reliability of function and smoothness of operation of respective indication lamps, tape reader, fan, and the like of the numerical control device.	1-57

Table 1 (Continued)

No.	Test item	Test method	Reference Corresponding number in 3.2 of JIS B 6201 and in 3.2.1 of JIS B 6330
8	Safety devices	Examine the safety for operators and the reliability of the machine protecting functions ⁽¹⁾ . The machine protecting functions means, for example, the travel limit automatic stopping functions of respective moving axes, and the emergency stopping function in case the synchronism of the control system is lost or the main spindle motor is overheated or overloaded [refer to JIS B 6014]	1-52
9	Lubrication devices	Examine the reliability of functions such as oil sealing and proper distribution of oil quantity.	1-53
10	Oil pressure and air pressure devices ⁽¹⁾	Examine the reliability of functions such as oil sealing, hermetic sealing, and pressure regulation.	1-54
11	Ancillaries	Examine the reliability of respective functions.	1-55

Notes ⁽¹⁾ This test item shall be applied to those machines having the indicated functions.

⁽²⁾ This test item shall be applied to machines incorporating a rotating table.

2.1.2 Function Test by Use of Numerical Control The function test by use of numerical control of machining centres (vertical type) shall be performed by operating the respective parts by using test numerical control tapes ⁽¹⁾ or other numerical control commands ⁽³⁾ according to Table 2.

Table 2

No.	Test item	Test method	Reference Corresponding number in 3.2 of JIS B 6201 and in 3.2.2 of JIS B 6330
1	Start, stop, and reverse rotation of main spindle and change of main spindle speed	Perform start, stop, and reverse rotation at a suitable main spindle speed and change the main spindle speed to three marked speeds-lowest, intermediate, and highest to examine the reliability of function and smoothness of operation.	1-13 1-14
2	Change of feed speed	Change the feed speed to three marked feed speeds-lowest, intermediate, and highest - and rapid feed, and perform start and stop with respect to the positive and negative directions of the respective feeds to examine the reliability of function and smoothness of operation. This test shall be performed on the respective control axes.	1-28
3	Indexing of rotating table ⁽²⁾	Perform indexing of the rotating table to examine the reliability of function and smoothness of operation.	1-34
4	Inching ⁽¹⁾	Perform inching operation on the respective control axes to examine the reliability of function and smoothness of operation.	1-21
5	Zero reset	Perform zero returning ⁽⁴⁾ from an arbitrary return position on the respective control axes to examine the reliability of function and smoothness of operation.	1-35

Table 2 (Continued)

No.	Test item	Test method	Reference Corresponding number in 3.2 of JIS B 6201 and in 3.2.2 of JIS B 6330
6	Automatic tool replacement	Perform automatic tool replacement to examine the reliability of function and smoothness of operation.	1-61
7	Other functions	Examine the reliability of function and smoothness of operation with respect to each of the other functions provided.	1-61

Notes ⁽³⁾ Other numerical control commands include cards, on-lines, input by manual data input devices, and other numerical control commands by manual input such as push buttons on the operating board.

⁽⁴⁾ The travel shall be made, as a rule, by rapid traverse and cover a distance of not smaller than that including the distances traversed by automatic acceleration and deceleration.

Remark: This test may be performed simultaneously with the continuous no-load running test.

2.2 No-Load Running Test In the no-load running test of machining centres (vertical type), the main spindle shall be operated by starting with the lowest speed, then at the speeds of respective stages, and at the highest speed continuously for 30 to 60 min as a rule. During this operation, the respective items specified in Recording Form 1 of Table 3 shall be measured [refer to 3.3 of JIS B 6330].

The feed speed used shall be the lowest, intermediate, highest, and rapid traverse, and the respective items specified in Recording Form 2 of Table 4 shall be measured for each speed.

In addition, vibration and noise shall be observed. Where vibration and noise are particularly made the problem, inspection shall be made in accordance with JIS B 6003 and JIS B 6004.

Table 3. Recording Form 1

No.	Time of measurement (h and min)	Main spindle speed s ⁻¹		Temperature °C			Required power (source frequency Hz)			Remarks
		Command	Actual measurement	Main bearings		Room temperature	Voltage V	Current A	No-load input kW	
				Upper	Lower					

Table 4. Recording Form 2

Measuring item (1)		Feed speed in X-axis direction mm/min		Feed speed in Y-axis direction mm/min		Feed speed in Z-axis direction mm/min		Feed speed in W-axis direction mm/min		Rotating speed around A-, B-, or C-axis direction by numerical command (5) degrees/min		Remarks
		Com-mand	Actual (6)	Com-mand	Actual (6)	Com-mand	Actual (6)	Com-mand	Actual (6)	Command	Actual (6)	
Feed speed												
Lowest												
Inter-mediate	Without override											
	With override (7)											
Highest												
Rapid traverse												

Notes (5) This measurement shall be carried out for machines incorporating rotating axes by numerical control.

(6) The actual measured value shall be recorded for respective speeds and their directions ($\pm$).

(7) Where the feed speed override function is operated, the override rate (%) shall be recorded in the command column.

2.3 Continuous No-Load Running Test The continuous no-load running test of machining centers (vertical type) shall be performed by running the machine continuously for about 2 h (6) by a test tape or other numerical control command (3) covering various functions and examining for the occurrence of abnormalities.

The test tape or other numerical control command (3) used in this test shall cover at least the following contents:

- (1) The main spindle speed shall include not less than 5 stages including the marked lowest, intermediate, and highest speeds and also include regular rotation, reverse rotation, and stop at each speed.
- (2) The feed speed shall consist of a combination of the marked lowest, intermediate, highest speeds and rapid traverse, and this combination of speeds shall almost cover the whole travelling range on each axis.
The rapid traverse shall be used for a distance of not smaller than $\frac{1}{2}$ of the travelling range on each axis.
- (3) On each axis, positioning (⁹) shall be performed at arbitrary positions almost covering the whole travelling range.
- (4) Automatic tool replacement shall be performed about 20 times.

Notes (⁸) The continuous running shall cover not less than two cycles.

- (⁹) For machines capable of simultaneous control of two or more axes, the positioning shall be performed including such a function.

Remark: No load shall be present on the table.

2.4 Loaded Running Test The loaded running test shall be performed by measuring the required power in the following cutting power test and observing the vibration and noise and the condition of the finished surface [refer to 3.4 of JIS B 6201]. Where vibration and noise are particularly made the problem, measurement shall be made according to JIS B 6003 and JIS B 6004.

In this test, the method of cutting shall be dry cutting.

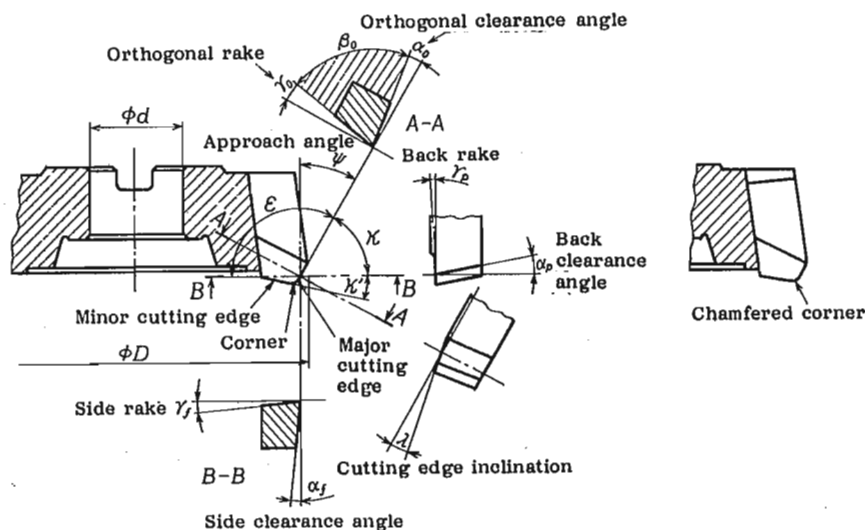
Cutting Power Test The cutting power test, a test to ascertain that the machine can withstand the prescribed power in high-speed cutting, shall be performed by conducting a face milling operation under the following conditions and measuring the prescribed power and observing the condition of the finished surface (refer to Recording Form 3 of Table 5) (refer to JIS B 6201, 3.4, No. 3-11).

Table 7. Recording Form 4

Carbide face milling cutter (¹⁰)								Remarks
Diameter mm	Number of cutting edges	Side rake angle degrees	Back rake degrees	Side clear- ance angle degrees	Back clear- ance angle degrees	Approach angle degrees	Cham- fered corner width mm	

Note (¹⁰) The names of respective parts of the tool cutting edge shall be as shown in Figure.

Figure

(2) Workpiece

Material The material of the workpiece shall, as a rule, be S 45 C specified in JIS G 4051 or SS 41 specified in JIS G 3101.

Shape The dimensions of the workpiece may be suitably decided according to the size of the machine.

(3) Cutting Conditions

Cutting speed $V \approx 100$ to 150 (m/min)

Depth of cut $t = 1, 2, 3, 4, 5 \dots$ (mm) This may be suitably selected according to the capacity of the machine.

Feed per cutting edge $s' \approx 0.1, 0.2, 0.3, 0.4, 0.5$ (mm)

Cutting width $w = \text{milling cutter diameter} \times 2/3$ (mm)

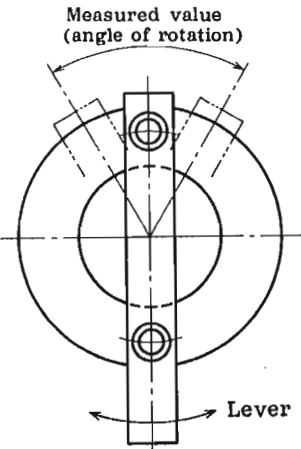
However, the cutting operation shall be stopped at the depth of cut obtained at that time when the prescribed power (refer to 3.4 of JIS B 6201) is reached, and when the prescribed power is not reached, the depth of cut shall be increased with an increment of 0.5 mm.

When the cutting operation has become extremely difficult due to chatter before the prescribed power is reached, the test shall be stopped under the cutting conditions used at that time.

- (4) Milling operation shall be performed by feeding in X-axis and Y-axis directions.

2.5 Backlash Test The backlash test of machining centers (vertical type) shall be performed as specified in Table 8.

Table 8

No.	Test item	Test method	Test method diagram	Reference (Corresponding number in 3.5 of JIS B 6201)
1	Overall backlash of main spindle driving system	Set the main spindle speed changing device to the highest and lowest speeds, and measure, for the two speeds respectively, the angle of rotation of the main spindle during the period to the moment the main shaft starts to rotate when the main spindle is moved toward the regular and reverse direction, respectively. In this case, the angle of rotation of the main shaft during the period to the moment the main spindle starts to rotate when the main shaft is moved toward the regular and reverse directions, respectively, may be measured. The backlash may be expressed by the angle of rotation of the main shaft.		4-11