

JIS

JAPANESE INDUSTRIAL STANDARD

**Test Code for Performance and
Accuracy of Numerically
Controlled Lathes**

JIS B 6331—1986

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Test Code for Performance and Accuracy of
Numerically Controlled Lathes

B 6331-1986

1. Scope

This Japanese Industrial Standard specifies the methods of test and inspection for the running performance, rigidity, machine accuracy and working accuracy of numerically controlled lathe with swing over bed 2 000 mm or under and travelling amount in direction of Z axis of carriage 10 000 mm or under.

Remark: The units and formulae shown in { } in this standard are based on the traditional units and are appended for reference.

2. Methods of Running Tests2.1 Functional Tests

2.1.1 Functional Test without Numerical Control The functional test without numerical control shall be conducted according to Table 1 by operating manually each part.

Applicable Standards:

JIS B 4105-Single Point Tools with Cemented Carbide Tips

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 Machine Tools

JIS G 4051-Carbon Steels for Machine Structural Use

JIS H 5501-Cemented Carbide Alloy to Tip

Table 1

No.	Test item	Testing method	Reference Corresponding No. in 3.2 of JIS B 6201 and 3.2.1 of JIS B 6330
1	Start, stop and running operation of spindle	Conduct start and stop (including inching and braking) in normal and reverse rotations with an adequate spindle speed ten times continuously to test the smoothness and reliability of actuation.	1-11
2	Changing operation of spindle speed ⁽¹⁾	Change the spindle speed to all indicated speeds ⁽¹⁾ to test the smoothness of actuation and reliability of indication of operating device.	1-12
3	Start, stop and running operation of carriage and cross slide	Conduct start and stop in plus and minus of normal and quick traverses with an adequate feed per revolution or feed speed ten times continuously to test the smoothness and reliability of actuation.	1-21
4	Changing operation of feed speed of carriage and cross slide	Change feed speed into 3 marked lowest, intermediate and highest feed speeds to test the smoothness of actuation and reliability of indication. As for quick traverse, test too the smoothness of actuation.	1-22
5	Changing operation of feed per revolution of carriage and cross slide	Change the feed per revolution into 3 marked smallest, intermediate and largest feed speeds to test the smoothness of actuation and reliability of indication.	1-23
6	Operation of carriage, cross slide and tool slide	Move manually the carriage, cross slide and tool slide to test the smoothness and uniformity of actuation. Further, test the reliability of function of micrometer collar.	1-27
7	Operation of tail stock and tailstock spindle ⁽²⁾	Move manually and mechanically the tail stock and tailstock spindle to test the smoothness and uniformity of actuation on overall length of motion.	1-33
8	Operation of fastening	As for each fastening mechanism of carriage, cross slide, tool slide and tailstock ⁽²⁾ , fasten at an arbitrary position of respective motions to test its reliability.	1-33

Table 1 (Continued)

No.	Test item	Testing method	Reference Corresponding No. in 3.2 of JIS B 6201 and 3.2.1 of JIS B 6330
9	Indexing operation of tool rest	Conduct indexing operation of tool rest to test the smoothness and reliability of actuation.	—
10	Operation to set and withdraw tool	Test the smoothness and reliability of setting and withdrawal of tool.	1-41
11	Electrical equipment	Test the insulation condition once respectively before and after running test. However, this does not apply to the circuits using semiconductors and the like.	1-51
12	Numerical control system	Test the smoothness of actuation and reliability of function of each indicating lamp, tape reader, fan, etc. in numerical control system.	1-57
13	Safety device	Test the safety for operator and reliability of machine protection function ⁽³⁾ (See JIS B 6014).	1-52
14	Lubricating device	Test the reliability of functions such as oil tightness, adequate distribution of oil, etc.	1-53
15	Hydraulic and pneumatic devices	Test the reliability of functions such as oil tightness, air tightness, pressure adjustment, etc.	1-54
16	Accessories	Test the reliability of functions.	1-55

Notes ⁽¹⁾ In the case of stepless speed change, conduct on three speeds of lowest, intermediate and highest ones.

⁽²⁾ Motion of tailstock body in relation to tailstock base is not conducted.

⁽³⁾ This designates, for example, automatic stop function at traverse limit of each moving axis, emergency stop function when the synchronism of control system is lost or when overheat or overload of electric motor for spindle occurs, etc.

2.1.2 Functional Test with Numerical Control The functional test with numerical control shall be conducted by actuating each part by numerically control tape for test and other numerical control commands⁽⁴⁾ in accordance with Table 2.

Table 2

No.	Test item	Testing method	Reference Corresponding No. of 3.2.2 of JIS B 6330
1	Start, reversal, stop of spindle and changing of spindle speed ⁽¹⁾	Rotate spindle and conduct start, stop, reversal and changing of spindle speed to all marked speeds to test the reliability of function and smoothness of actuation.	1-13 1-14
2	Start, stop of feed and changing of feed speed	Change into three feed speeds of marked lowest, intermediate and highest ones and into quick traverse, conduct start and stop in plus and minus of each feed to test the reliability of function and smoothness of actuation.	1-28
3	Indexing of tool rest	Conduct the indexing of tool rest to test the reliability of function and smoothness of actuation.	1-34
4	Zero resetting	For each control axis, conduct zero resetting ⁽⁵⁾ from arbitrary position capable of zero resetting to test the reliability of function and smoothness of actuation.	1-35
5	Other functions	As for other functions equipped with, test the reliability of function and smoothness of actuation in each.	1-61

Notes ⁽⁴⁾ Other numerical control commands include the numerical control commands by input by card, on-line, manual data input device and manual input by push button on operating panel, etc.

⁽⁵⁾ The motion shall, in general, be quick traverse and be in distance not less than that including automatical acceleration and deceleration.

Remark: This test may be conducted simultaneously with continuous no load running test.

2.2 No Load Running Test The no-load running test shall be conducted by running at each step beginning from the lowest speed of spindle and then continuing the running at highest speed for 30 to 60 min in general to measure each item specified in Table 3. Record Format 1-1 (see 3.3 of JIS B 6330).

Further, at an adequate spindle speed, the feed per revolution or feed speed shall be taken at minimum (low), intermediate and maximum (high) ones to measure each item specified in Table 4. Record Format 1-2.

Moreover, the vibration and noise shall be observed. Where the vibration and noise shall be studied particularly, JIS B 6003 and JIS B 6004 shall apply.

Table 3. Record Format 1-1

Number	Time of measurement o'clock-minute	Spindle speed $\text{min}^{-1}\{\text{rpm}\}$		Temperature $^{\circ}\text{C}$			Required electric power (source frequency Hz)			Description
		Marked	Measured value	Main bearing		Room temperature	Voltage V	Current A	Input kW	
				Front	Rear					

Table 4. Record Format 1-2

Measurement item Test item			Command mm per revolution or mm/min	Measured value mm per revolution or mm/min	Description
Feed per revolution or feed speed	Direction of X axis	Minimum (low)			
		Intermediate			
		Maximum (high)			
		Quick traverse			
	Direction of Z axis	Minimum (low)			
		Intermediate			
		Maximum (high)			
		Quick traverse			

2.3 Continuous No Load Running Test In the continuous no load running test, the continuous running shall be conducted by test tape or other numerical control commands⁽⁴⁾ including each function⁽⁶⁾ for about 2 h⁽⁷⁾ to test the existence of abnormalities (see 3.4 of JIS B 6330).

In this case, the spindle speed, feed and automatic indexing of tool rest included in numerical command shall be in accordance with the following.

- (1) The spindle speed includes the speed change over all the range of speed change, normal and reverse rotations, start and stop.
- (2) Feed shall be minimum (low), intermediate, maximum (high) and quick traverse. The moving distance shall be approximately the whole marked range and quick traverse of 1/2 or over of moving distance in each axis shall be included.
- (3) Automatic indexing of tool rest shall be conducted on all positions to be indexed.

Notes ⁽⁶⁾ For those equipped with synchronous dual axes control function, this function shall be included.

⁽⁷⁾ It shall be continuous running of two cycles or over.

2.4 Load Running Test In load running test, the cutting power test, chatter test and cutting torque test shall be conducted to measure the required electric powers.

Furhter, the vibration, noise and state of finished surface shall be observed (see 3.5 of JIS B 6330).

Where the vibration and noise are particularly studied, JIS B 6003 and JIS B 6004 shall apply.

2.4.1 Cutting Power Test For cutting power test, the high speed turning shall be conducted according to the following conditions to test that the defined power is endured (see Table 5. Record Format 2) (see Number 3-11 of JIS B 6201).

Table 5. Record Format 2

Number	Work		Cutting conditions					Required electric power (source frequency Hz)					Description
	Diameter	Material	Spindle speed	Cutting speed	Depth of cut	Feed per revolution	Area of cut	Voltage	Current	Input	Input under no load ⁽⁸⁾	Cutting power	
	(d)		(n)	(V _c)	(a)	(S)	(a · S)			(W)	(W ₀)	(W - W ₀)	
	mm		min ⁻¹ {rpm}	m/min	mm	mm per revolution	mm ²	V	A	kW	kW	kW	

Note ⁽⁸⁾ This designates the input under no load obtained in the condition where the defined work is attached.

- (1) Tool The tool shall, in general, be Type 31 or Type 32 specified in JIS B 4105.
- (2) Work The material shall, in general, be S 45 C specified in JIS B 4051 and the dimensions shall comply with Table 6.

Table 6

Unit: mm

Division \ Work	Diameter d (approx.)	Length l
In the case of centre work	Diameter in which cutting speed $V_c \doteq 120$ m/min is obtained. However, where its numerical value is under $D/10$, it shall be $D/10$.	$\frac{D}{2}$ to D
In the case of chuck work	$\frac{D}{4}$ to $\frac{D}{2}$	$\frac{D}{4}$ max.

where D : swing over bed (mm) l : length excluded with tong hold

- (3) Cutting Conditions Feed per revolution S

$$S \doteq \frac{D}{4000}, \frac{D}{2000}, \frac{D}{1600}, \frac{D}{1250}, \frac{D}{1000} \text{ (mm per revolution)}$$

where D : swing over bed (mm)

However, when the defined electric power has been reached, test shall be stopped.

Depth of cut (a) } shall, in general, be the numerical values
 Cutting speed (V_c) } given in Table 7. However, where the cutting
 speed given in Table 7 can not be attained on
 account of structure of machine, the highest
 speed shall be used.

Table 7

Swing over bed (<i>D</i>) mm	Depth of cut(⁹) (<i>l</i>) mm (approx.)	Cutting speed () m/min
200	1.7	About 120
250	2.1	
315	2.6	
400	3.3	
500	4.2	
630	5.3	
800	6.7	
1 000	8.3	
1 250	10.4	
1 600	13.3	
2 000	17.0	

Note (⁹) When the swing over bed is not given in table 7, $D/120$ shall apply.

2.4.2 Chatter Test As for chatter test, the radial feed cutting shall be conducted under the following conditions to observe chatter state and test the stability of cutting (see Table 8, Record Format 3) (see Number 3-14 of JIS B 6201).

Table 8. Record Format 3

Number	Work		Cutting conditions					Chatter state	Description
	Diameter	Material	Spindle speed	Cutting speed	Feed per revolution	Width of cut	Distance from end face of chuck to top end of work		
	(<i>d</i>) mm		(<i>n</i>) min ⁻¹ {rpm}	(<i>V_c</i>) m/min	(<i>S</i>) mm per revolution	(<i>b</i>) mm	(<i>l</i>) mm		

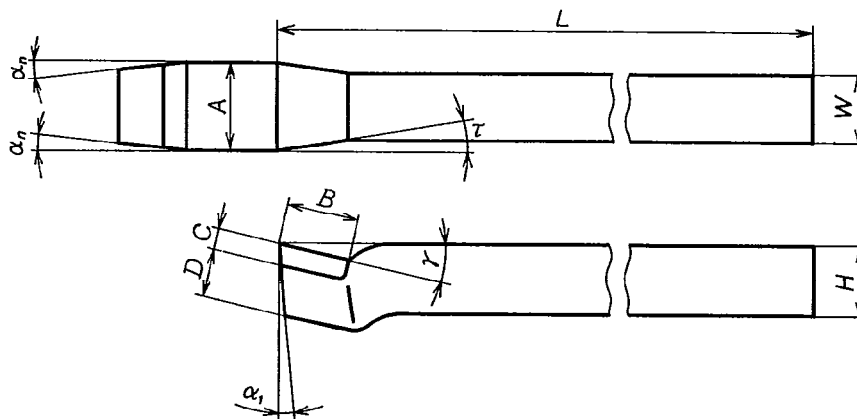
- (1) **Tool** The material of tool shall be as given in JIS H 5501 and as for form and dimensions, the necessary items shall be recorded according to Table 9 Record Format 4. Further, length of ejection of tool shall be recorded.

Table 9. Record Format 4

γ	α_1	α_n	τ	A	W	H	L
degree	degree	degree	degree	mm	mm	mm	mm

Remark: The form of tool and symbols of dimensions shall be as shown in Fig. 1.

Fig. 1



- (2) **Work** the material shall, in general, be S 45 C specified in JIS G 4051 and the dimensions shall be as follows.

$$\text{Diameter: } d = \frac{D}{5}$$

where D : swing over bed (mm)

$$\text{Length: } l = d \text{ (mm)}$$

Remark: The length l shall be as given in Fig. 2 (it is not length of work).