

# JIS

**JAPANESE INDUSTRIAL STANDARD**

**Test Code for Performance and  
Accuracy of Knee Type  
Horizontal and Universal  
Milling Machines**

**JIS B 6203—1986**

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## JAPANESE INDUSTRIAL STANDARD

J I S

Test Code for Performance and Accuracy of  
Knee Type Horizontal and Universal Milling Machines

B 6203-1986

1. Scope

This Japanese Industrial Standard specifies testing and inspecting methods related to the running performances, rigidity, mechanical accuracy and machining accuracy for knee type horizontal milling machines and universal milling machines of 1500 mm or under in left and right travelling amount of table.

- Remarks 1. The coordinate axes of machines to be used in this standard are in accordance with the following [see JIS B 6310].
- Z-axis: The Z-axis is taken in a parallel direction to the main spindle (front and rear direction).
- X-axis: The X-axis is taken in a vertical direction to the Z-axis in the horizontal plane (left and right direction).
- Y-axis: The Y-axis is taken in a vertical direction to the Z-axis and the X-axis (up and down direction).
2. The units, numerical values and formulae given in { } in this standard are in accordance with the conventional units, and are appended for reference.

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Applicable Standards:

JIS B 4205-Plain Milling Cutters

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 6310-Axis and Motion Nomenclature for Numerically Controlled Machine Tools

JIS G 4051-Carbon Steels for Machine Structural Use

## Corresponding International Standard:

ISO 1701-Test conditions for milling machines with table of variable height, with horizontal or vertical spindle-Testing of the

## 2. Testing Methods on Running

2.1 Functional Tests The functional tests shall be carried out in accordance with Table 1.

Table 1

| No. | Test item                                                 | Testing method                                                                                                                                                                                                                                                                                                                                                                                                                     | Reference<br>Corresponding<br>No. in 3.2 of<br>JIS B 6201 |
|-----|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| 1   | Starting, stopping and running operations of main spindle | Carry out 10 times of starting and stopping (including braking) continuously in respect to normal revolution and reverse revolution at an appropriate main spindle speed to examine the smoothness and reliability of workings.                                                                                                                                                                                                    | 1-11                                                      |
| 2   | Changing operation of main spindle speed                  | Change the main spindle speed in respect to all of the marked speeds <sup>(1)</sup> to examine the smoothness of workings and reliability of indications.                                                                                                                                                                                                                                                                          | 1-12                                                      |
| 3   | Changing operation of feed speed                          | Change the feed speed in respect to all of the marked feeds for the feed in X-axis direction of a table, and in respect to 3 feed speeds of the lowest, intermediate and the highest for that of a variable speed system, to examine the smoothness of workings and reliability of indications.<br><br>Regarding the feeds in Z-axis direction and Y-axis direction of the table, carry out the similar test at an arbitrary feed. | 1-22                                                      |
| 4   | Hand feed operation of table                              | Allow to travel the table with hand feed handle in X-axis direction, Z-axis direction and Y-axis direction to examine the smoothness and uniformity of workings over the overall length of motions. In addition, examine the reliability of functions of a micrometer collar.                                                                                                                                                      | 1-27                                                      |

Table 1 (Continued)

| No. | Test item                                                                          | Testing method                                                                                                                                                                                                                                                                                                                                     | Reference Corresponding No. in 3.2 of JIS B 6201 |
|-----|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| 5   | Operation of engaging and disengaging device of power feed and rapid feed of table | Regarding the power feed and rapid feed of table in X-axis direction, Z-axis direction and Y-axis direction, and regarding the setting of position and working of engaging and disengaging by hand motion and automatic motion, examine the smoothness and reliabilities respectively.                                                             | 1-21<br>1-31                                     |
| 6   | Operation of supporting device of arbour                                           | Travel the over arm and arbour support over the overall length of motion to examine the smoothness and uniformity of workings.                                                                                                                                                                                                                     | —                                                |
| 7   | Swivelling operation of table                                                      | Swivel the table respectively by about 45 deg to both sides from the position of centre of swivelling, to examine the smoothness.                                                                                                                                                                                                                  | —                                                |
| 8   | Clamping operation                                                                 | Regarding respective clamping mechanisms of the table, saddle, knee, over arm, arbour support and brace, clamp at an arbitrary position in respective motions to examine the reliability.<br><br>In addition, for that of which table swivels <sup>(2)</sup> , examine the reliability of clamping at positions of both ends and centre of swivel. | 1-33                                             |
| 9   | Electric apparatus                                                                 | Examine the insulating condition once each before and after of the running test. However, this is not applicable to a circuit using semiconductors and the like.                                                                                                                                                                                   | 1-51                                             |
| 10  | Safety device                                                                      | Examine the safety for workers and the reliability for machine protecting functions (see JIS B 6014).                                                                                                                                                                                                                                              | 1-52                                             |
| 11  | Lubricating device                                                                 | Examine the reliability of functions such as oil tightness, adequate distribution of amount of oil and the like.                                                                                                                                                                                                                                   | 1-53                                             |
| 12  | Oil hydraulic apparatus                                                            | Examine the reliability of functions such as oil tightness, pressure regulation and the like.                                                                                                                                                                                                                                                      | 1-54                                             |

Table 1 (Continued)

| No. | Test item                         | Testing method                        | Reference Corresponding No. in 3.2 of JIS B 6201 |
|-----|-----------------------------------|---------------------------------------|--------------------------------------------------|
| 13  | Accessories                       | Examine the reliability of functions. | 1-55                                             |
| 14  | Backlash eliminator of feed screw | Examine the reliability of functions. | 1-56                                             |

Notes (1) In the case of the variable speed system, operations shall be carried out on the three speeds of the lowest, intermediate and the highest.

(2) This is carried out on the universal milling machine.

2.2 No-load Running Test The no-load running test shall be carried out in accordance with the following:

- (1) In Relation to Main Spindle With starting from the lowest speed of the main spindle, run at respective steps, continue running for 30 to 60 min, in general, at the highest speed succeeding, and measure respective items specified in Table 2 Recording Form 1-1 [see 3.3 of JIS B 6201].

In addition, observe vibrations and noises. In the case where the vibrations and noises are particularly in question, refer to JIS B 6003 and JIS B 6004.

Table 2. Recording Form 1-1

| No. | Measuring time<br>o'clock·min | Main spindle speed<br>min <sup>-1</sup> (rpm) |                       | Temperature °C  |      |                   |      | Required electric power<br>(power source<br>frequency Hz) |              |              | De-<br>scription |             |
|-----|-------------------------------|-----------------------------------------------|-----------------------|-----------------|------|-------------------|------|-----------------------------------------------------------|--------------|--------------|------------------|-------------|
|     |                               | Marking                                       | Actual<br>measurement | Main<br>bearing |      | Arbour<br>bearing |      | Room<br>tempera-<br>ture                                  | Voltage<br>V | Current<br>A |                  | Input<br>kW |
|     |                               |                                               |                       | Front           | Rear | Front             | Rear |                                                           |              |              |                  |             |
|     |                               |                                               |                       |                 |      |                   |      |                                                           |              |              |                  |             |
|     |                               |                                               |                       |                 |      |                   |      |                                                           |              |              |                  |             |
|     |                               |                                               |                       |                 |      |                   |      |                                                           |              |              |                  |             |

- (2) In Relation to Feed With respect to the 3 feed speeds of the lowest, intermediate and the highest, and rapid feed, measure respective items specified in Table 3 Recording Form 1-2 (see 3.3 of JIS B 6201). For those machines of which feed motors are separated from the main spindle motors, measure only for the feed motors. For those which are not separated, record in the description column to that effect, and, in this case, run the main spindle at the lowest speed.

In addition, observe vibrations and noises. In the case where the vibrations and noises are particularly in question, refer to JIS B 6003 and JIS B 6004.

Table 3. Recording Form 1-2

| No. | Feed in X-axis direction of table |                    |                                                                    |           |          | Feed in Z-axis direction of table <sup>(3)</sup> |                    |                                                     |           |          | Feed in Y-axis direction of table |                                   |                                                                    |           |          | Description |
|-----|-----------------------------------|--------------------|--------------------------------------------------------------------|-----------|----------|--------------------------------------------------|--------------------|-----------------------------------------------------|-----------|----------|-----------------------------------|-----------------------------------|--------------------------------------------------------------------|-----------|----------|-------------|
|     | Feed speed mm/min                 |                    | Required electric power <sup>(5)</sup> (power source frequency Hz) |           |          | Feed speed mm/min                                |                    | Required electric power (power source frequency Hz) |           |          | Feed speed mm/min                 |                                   | Required electric power <sup>(5)</sup> (power source frequency Hz) |           |          |             |
|     | Marking                           | Actual measurement | Voltage V                                                          | Current A | Input kW | Marking                                          | Actual measurement | Voltage V                                           | Current A | Input kW | Marking                           | Actual measurement <sup>(4)</sup> | Voltage V                                                          | Current A | Input kW |             |
|     |                                   |                    |                                                                    |           |          |                                                  |                    |                                                     |           |          |                                   |                                   |                                                                    |           |          |             |
|     |                                   |                    |                                                                    |           |          |                                                  |                    |                                                     |           |          |                                   |                                   |                                                                    |           |          |             |
|     |                                   |                    |                                                                    |           |          |                                                  |                    |                                                     |           |          |                                   |                                   |                                                                    |           |          |             |

Notes <sup>(3)</sup> Even though all of the strokes have finished feeding, if it is considerably difficult to measure electric power since measuring time is too short to measure, the measurement of the rapid feed or the highest feed speed may be omitted.

<sup>(4)</sup> Record the speed and its direction ( $\pm$ ).

<sup>(5)</sup> When the required electric power differs according to directions, record on each of them.

**2.3 Load Running Test** In the load running test, measure required electric power with carrying out cutting power test and chattering test.

In addition, observe vibrations, noises and condition of finished surface (see 3.4 of JIS B 6201). In the case where vibrations and noises are particularly in question, refer to JIS B 6003 and JIS B 6004.

Furthermore, apply a dry cutting.

In the cutting power test, examine that the machine is endurable to the specified electric power, and in the chattering test, examine the stability in cutting, carrying out planing under the following conditions to measure required electric power and to observe chattering condition (see Table 4 Recording Form 2) (see No. 3-11 and No. 3-14 of JIS B 6201).

Table 4. Recording Form 2

| Material of work piece |                                                            |                                                 |                                 |                                 |                                               |                                                          | Diameter of tool                                                   |           |           |               |                  | Number of cutting edges           |           |           |               |                                                              |                       |             |
|------------------------|------------------------------------------------------------|-------------------------------------------------|---------------------------------|---------------------------------|-----------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------|-----------|-----------|---------------|------------------|-----------------------------------|-----------|-----------|---------------|--------------------------------------------------------------|-----------------------|-------------|
| No.                    | Cutting conditions <sup>(6)</sup>                          |                                                 |                                 |                                 |                                               |                                                          | Required electric power <sup>(7)</sup> (power source frequency Hz) |           |           |               |                  |                                   |           |           |               | Removal rate per 1 kW <sup>(9)</sup><br>cm <sup>3</sup> /min | Chattering conditions | Description |
|                        |                                                            |                                                 |                                 |                                 |                                               |                                                          | Power for main spindle                                             |           |           |               | Power for feed   |                                   |           |           |               |                                                              |                       |             |
|                        | Main spindle speed<br>( <i>n</i> ) min <sup>-1</sup> (rpm) | Cutting speed<br>( <i>V<sub>c</sub></i> ) m/min | Depth of cut<br>( <i>a</i> ) mm | Width of cut<br>( <i>b</i> ) mm | Feed speed<br>( <i>V<sub>f</sub></i> ) mm/min | Feed per one cutting edge<br>( <i>S<sub>z</sub></i> ) mm | Removal rate cm <sup>3</sup> /min                                  | Voltage V | Current A | Load input kW | No-load input kW | Cutting power ( <sup>8</sup> ) kW | Voltage V | Current A | Load input kW |                                                              |                       |             |
|                        |                                                            |                                                 |                                 |                                 |                                               |                                                          |                                                                    |           |           |               |                  |                                   |           |           |               |                                                              |                       |             |
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|                        |                                                            |                                                 |                                 |                                 |                                               |                                                          |                                                                    |           |           |               |                  |                                   |           |           |               |                                                              |                       |             |

Notes <sup>(6)</sup> Distinction of the upward milling and downward milling shall be filled in the description column.

<sup>(7)</sup> Regarding that of which main-spindle motor is not separated from the feed motor, this shall be filled in the column of the power for main spindle, and it shall be recorded in the description column to that effect.

<sup>(8)</sup> This means the difference between the load input and the no-load input.

<sup>(9)</sup> The required electric power, in the case of obtaining the removal rate per 1 kW, shall be the sum of the load input for main spindle and the load input for feed.

- (1) Tools The tools shall generally be JIS B 4205, and the required matters shall be recorded in accordance with Table 6 Recording Form 3 by Table 5.

Table 5

Unit: mm

| Diameter of arbour <sup>(10)</sup> | Outside diameter of plain milling cutter (approx.) |
|------------------------------------|----------------------------------------------------|
| 27                                 | 63                                                 |
| 32                                 | 80                                                 |
| 40                                 | 100                                                |
| 50                                 | 125                                                |

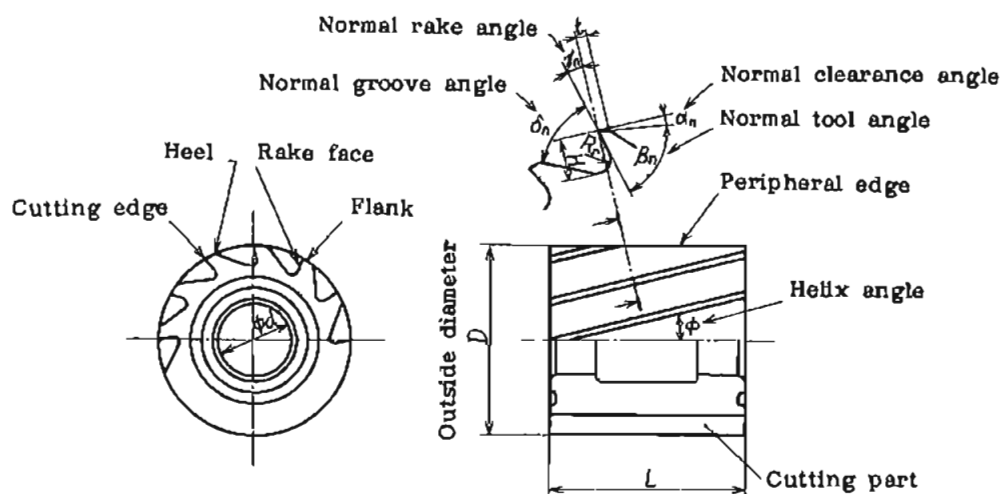
Note <sup>(10)</sup> For the diameter of arbour, that has been specified in the specification of machine shall be used.

Table 6. Recording Form 3

| Arbour         | Tool <sup>(11)</sup>      |                                          |                               |                                       |                         |                              | De-<br>scription |
|----------------|---------------------------|------------------------------------------|-------------------------------|---------------------------------------|-------------------------|------------------------------|------------------|
| Diameter<br>mm | Outside<br>diameter<br>mm | Number of<br>cutting<br>edges<br>(piece) | Normal<br>rake angle<br>(deg) | Normal<br>clearance<br>angle<br>(deg) | Helix<br>angle<br>(deg) | Left or<br>right of<br>helix |                  |
|                |                           |                                          |                               |                                       |                         |                              |                  |
|                |                           |                                          |                               |                                       |                         |                              |                  |
|                |                           |                                          |                               |                                       |                         |                              |                  |

Note <sup>(11)</sup> The names for cutting edge of the tool shall be as given in Figure.

Figure

(2) Work Piece

**Material:** The material shall generally be S 45 C specified in JIS G 4051.

**Shape:** The dimensions of cutting part shall conform to Table 7. The height of the work piece, however, may be determined appropriately.