
**Test conditions for surface grinding
machines with two columns — Machines
for grinding slideways — Testing of the
accuracy**

*Conditions d'essai des machines à rectifier les surfaces planes à deux
montants — Machines à rectifier les glissières — Contrôle de la précision*

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ISO 4703:2001

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4703 was prepared by Technical Committee ISO/TC 39, *Machine Tools*, Subcommittee SC 2, *Test conditions for metal cutting machine tools*.

This third edition cancels and replaces the second edition (ISO 4703:1984), which has been technically revised.

Annex A of this International Standard is for information only. (standards.iteh.ai)

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Test conditions for surface grinding machines with two columns — Machines for grinding slideways — Testing of the accuracy

1 Scope

This International Standard specifies, with reference to ISO 230-1 and ISO 230-2, geometric tests, machining tests and tests for checking accuracy and repeatability of positioning on general purpose and normal accuracy surface grinding machines with two columns for grinding slideways. It also specifies the applicable tolerances corresponding to the above-mentioned tests.

This International Standard is applicable to machines with rectilinear grinding movements and with a movable table. It does not include machines with a fixed table or with a rotary table movement.

This International Standard deals only with the verification of the accuracy of the machine. It does not apply to the testing of the machine operation (vibration, abnormal noises, stick-slip motion of components, etc.) nor to machine characteristics (such as speeds, feeds, etc.), which should generally be checked before testing the accuracy.

This International Standard provides the terminology used for the principal components of the machine and the designations of the axes with reference to ISO 841^[1].

NOTE In addition to terms used in the three official ISO languages (English, French and Russian), annex A of this International Standard gives the equivalent terms in the German and Italian languages; these are published under the responsibility of the member bodies for Germany (DIN) and Italy (UNI). However, only the terms given in the official languages can be considered as ISO terms.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

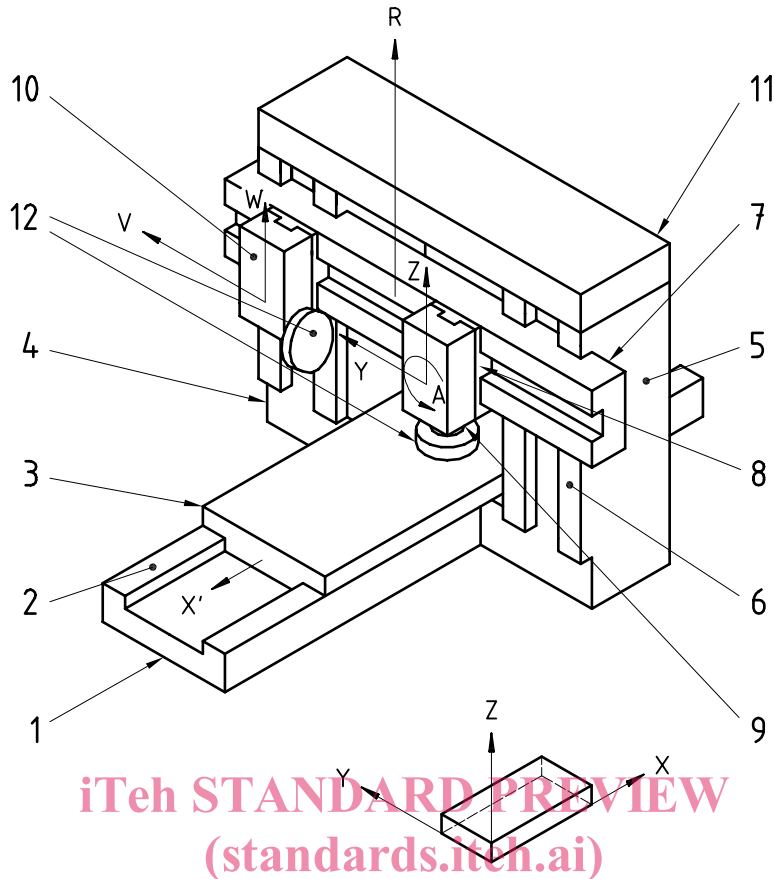
ISO 230-1:1996, *Test code for machine tools — Part 1: Geometric accuracy of machines operating under no-load or finishing conditions*

ISO 230-2:1997, *Test code for machine tools — Part 2: Determination of accuracy and repeatability of positioning numerically controlled axes*

3 Terminology and designation of axes

See Figure 1 and Table 1.

NOTE If the horizontal spindle is considered to be the main spindle, axis designations (Y-Z and V-W) may be exchanged. In this case, R will be replaced by Q. In these circumstances, axis designation in the individual tests may be changed accordingly.



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Figure 1
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Table 1

| No. | English | French | Russian |
|-----|--|--|--|
| 1 | Bed | Banc | Станина |
| 2 | Slideway | Glissière | Направляющие |
| 3 | Table | Table | Стол |
| 4 | Left-hand column | Montant gauche | Левая стойка |
| 5 | Right-hand column | Montant droit | Правая стойка |
| 6 | Slideway, right-hand column | Glissière, montant droit | Направляющие; правая стойка |
| 7 | Cross-rail | Traverse mobile (coulisseau vertical) | Траверса |
| 8 | Saddle | Chariot | Салазки |
| 9 | Right-hand wheelhead (vertical spindle) | Poupée porte-meule de droite (broche à axe vertical) | Правая шпиндельная бабка (с вертикальным шпинделем) |
| 10 | Left-hand wheelhead (horizontal spindle) | Poupée porte-meule de gauche (broche à axe horizontal) | Левая шпиндельная бабка (с горизонтальным шпинделем) |
| 11 | Bridge | Entretoise | Поперечная балка |
| 12 | Grinding wheel | Meule | Шлифовальный круг |

4 Preliminary remarks

4.1 Measuring units

In this International Standard, all linear dimensions, deviations and corresponding tolerances are expressed in millimetres; angular dimensions are expressed in degrees, and angular deviations and the corresponding tolerances are expressed in ratios but, in some cases, microradians or arcseconds may be used for clarification purposes. The equivalence of the following expressions should always be kept in mind:

$$0,010/1\ 000 = 10\ \mu\text{rad} \approx 2''$$

4.2 Reference to ISO 230-1

To apply this International Standard, reference shall be made to ISO 230-1, especially for the installation of the machine before testing, warming up of the spindle and other moving components, description of measuring methods and recommended accuracy of testing equipment.

In the "Observations" box of the tests described in the following clauses, the instructions are accompanied by a reference to the corresponding clause in ISO 230-1 in cases where the test concerned is in compliance with the specifications of ISO 230-1.

Reference should be made to ISO 230-2 for positioning tests.

4.3 Testing sequence

The sequence in which the tests are presented in this International Standard in no way defines the practical order of testing. In order to make the mounting of instruments or gauging easier, tests may be performed in any order.

4.4 Tests to be performed

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When testing a machine, it is not always necessary or possible to carry out all the tests described in this International Standard. When the tests are required for acceptance purposes, it is up to the user to choose, in agreement with the supplier/manufacturer, those tests relating to the components and/or the properties of the machine which are of interest. These tests are to be clearly stated when ordering a machine. Mere reference to this International Standard for the acceptance tests, without specifying the tests to be carried out, and without agreement on the relevant expenses, cannot be considered as binding for any contracting party.

4.5 Measuring instruments

The measuring instruments indicated in the tests described in clauses 6, 7 and 8 are examples only. Other instruments measuring the same quantities and having at least the same accuracy may be used. Dial gauges shall have a resolution of at least 0,001 mm.

4.6 Minimum tolerance

When establishing the tolerance for a measuring length different from that given in this International Standard (see 2.311 of ISO 230-1:1996), it shall be taken into consideration that the minimum value of tolerance is 0,005 mm.

4.7 Machining tests

Machining tests shall be made with finishing cuts only. Roughing cuts shall be avoided since they are liable to generate appreciable cutting forces.

5 Specific installation conditions

5.1 Foundations

Foundations are essential for providing the necessary stiffness to this type of machine which should always be installed in the user's workshop on foundations designed and manufactured correctly.

Foundations suitable to every type of machine are not always available in the manufacturer's assembly workshop; therefore, if the test is being carried out on a machine simply resting on the floor, this shall be taken into account and recorded on the test report.

5.2 Isolation

Foundations should be isolated from the surrounding floor in order not to transmit vibrations and/or heat.

5.3 Thermal conditions

When the table is hydraulically operated, it is subject to thermal distortions due to the temperature difference between the oil beneath and the coolant on its top. The test shall then be carried out after moving the table and delivering coolant for a time sufficient to let it reach the working condition, following the manufacturer's instructions.

5.4 Testing temperature

The test room temperature variation should not exceed 2 °C. Otherwise, the ambient temperature conditions throughout the tests shall be specified by agreement between the supplier/manufacturer and user. The machine should be placed in this environment at least 24 h prior to the tests.

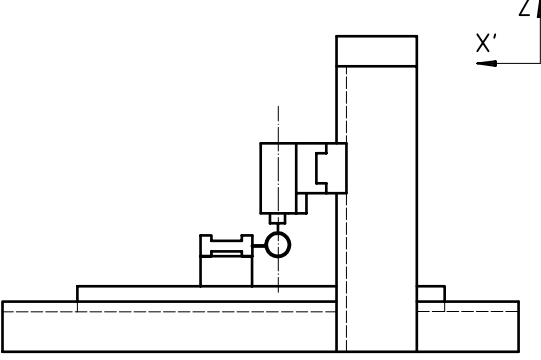
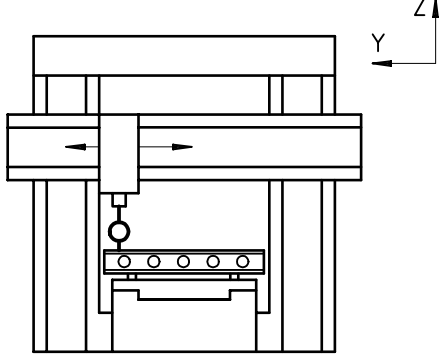
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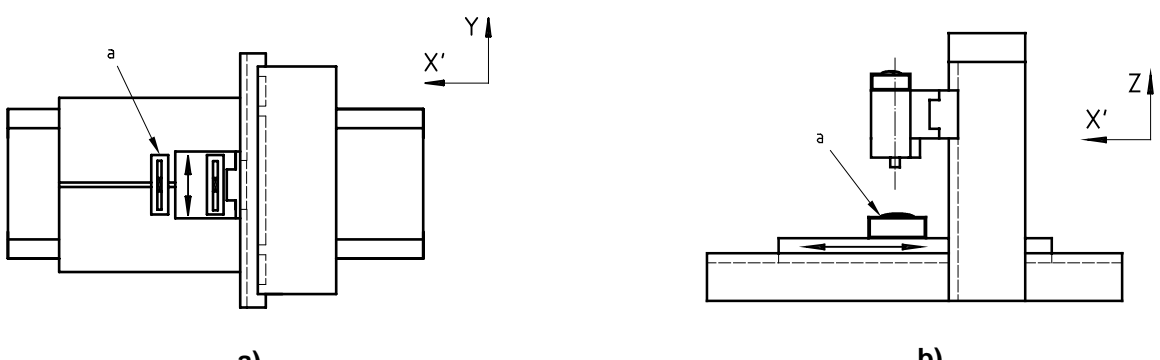
6 Geometric tests

6.1 Axes of motion

| | | |
|--|--|--|
| Object | | G1 |
| <p>Checking of straightness of the table longitudinal movement (X-axis):</p> <p>a) in the horizontal XY-plane (EYX);</p> <p>b) in the vertical ZX-plane (EZX).</p> | | |
| Diagram | | |
| | | |
| Tolerance | | Measured deviation |
| <p>a) and b)</p> <p>0,02 for measuring lengths up to 2 000</p> <p>add 0,01 for each 1 000 increase in length, for length greater than 2 000 mm</p> <p>Maximum tolerance: 0,10</p> <p>Local tolerance: 0,01 for any measuring length of 1 000</p> | | <p>For X =</p> <p>a)</p> <p>b)</p> |
| Measuring instruments | | |
| Optical methods | | |
| Observations and references to ISO 230-1:1996 | | |
| | | 5.232.12, 5.232.13 and 5.232.14 |
| <p>The optical component is mounted on the wheelhead in order to reduce effects of the non-rigid table. The support of the bridge should be at the same distance as the support of the workpiece.</p> <p>When mounting the telescope, be aware of the possible flexibility of the table.</p> | | |

| | | |
|--|--|---------------------------|
| Object | | G2 |
| Checking of angular deviation of the table longitudinal movement (X-axis): a) in the ZX-plane (EBX: pitch); b) in the vertical YZ-plane (EAX: roll). | | |
| Diagram | | |
| | | |
| a Reference level | | |
| Tolerance | | Measured deviation |
| | a) b) X ≤ 4 000 0,04/1 000 0,02/1 000 X > 4 000 0,06/1 000 0,03/1 000 | For X = a) b) |
| Measuring instruments Precision level or optical methods | | |
| Observations and references to ISO 230-1:1996 5.231.3, 5.232.2 and 5.232.21 | | |
| One level shall be placed on the movable component: a) (EBX: pitch); in the X-axis direction; b) (EAX: roll); in the Y-axis direction. | | |
| When the X-axis motion causes an angular deviation of both spindle head and work holding table, differential measurements of the two angular deviations shall be made, and this shall be stated. | | |
| The reference level shall be located on the spindle head, and the head shall be in the middle of the travel range. | | |
| Measurements shall be carried out in at least five equally spaced positions with a maximum distance of 1 000, along the travel in both directions of movement. | | |
| The difference between the maximum reading and the minimum reading of the two directions shall not exceed the tolerance. | | |
| Measurements shall be repeated with the level placed at two ends (within 500 mm from the edges) and at the middle of the table. | | |

| | |
|--|---|
| <p>Object</p> | <p>G3</p> |
| <p>Checking of the straightness of the wheelhead saddle movement on the cross-rail (Y-axis):</p> <p>a) in the XY-plane (horizontal plane) (EXY);</p> <p>b) in the YZ-plane (vertical plane) (EZY).</p> | |
| <p>Diagram</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>a)</p> </div> <div style="text-align: center;">  <p>b)</p> </div> </div> | |
| <p>Tolerance</p> <p>a) and b)</p> <p>0,02 for measuring lengths $\leq 1\ 000$;</p> <p>add 0,01 for each 1 000 increase in length, for length greater than 1 000 mm</p> <p>Maximum tolerance: 0,04</p> <p>Local tolerance: 0,01 for any measuring length of 500</p> | <p>Measured deviation</p> <p>For Y =</p> <p>a)</p> <p>b)</p> |
| <p>Measuring instruments</p> <p>Straightedge, dial gauge and gauge blocks or optical methods</p> | |
| <p>Observations and references to ISO 230-1:1996 5.232.1, 5.232.11 and 5.232.13 and 5.232.14</p> <p>Fix the cross-rail at mid-height and place the table at the mid-travel.</p> <p>Set up the straightedge on the table, parallel¹⁾ to the Y-axis movement of the grinding head; for a) horizontally and for b) vertically.</p> <p>Fix a dial gauge support on the grinding head such that the dial gauge stylus is normal to the reference face of the straightedge.</p> <p>Traverse the grinding head in Y-direction through the measuring length²⁾ and note the readings.</p> <hr/> <p>1) Parallel means: readings of the dial gauge touching the straightedge at both ends of the movement show the same value and, in this case, the maximum difference of the readings gives the straightness deviation.</p> <p>2) Measuring length means not the full length of cross-rail but the effective travel of the grinding head (usually the length between two columns).</p> | |

| | |
|--|--|
| <p>Object</p> | <p>G4</p> |
| <p>Checking of the angular deviations of the Y-axis movement of the wheelhead saddle movement on the cross-rail (Y-axis):</p> <p>a) in the YZ-plane (EAY: pitch);</p> <p>b) in the ZX-plane (EBY: roll).</p> | |
| <p>Diagram</p>  <p>a) Reference level</p> | |
| <p>Tolerance</p> <p>a) and b) 0,04/1 000</p> <p>Local tolerance: 0,02/1 000 (or 20 μrad or 4") for any measuring length of 250</p> | <p>Measured deviation</p> <p>a)</p> <p>b)</p> |
| <p>Measuring instruments</p> <p>Precision level or optical methods</p> | |
| <p>Observations and references to ISO 230-1:1996 5.231.3, 5.232.2 and 5.232.21</p> <p>One level shall be placed on the movable component:</p> <p>a) (EAY: pitch); in the Y-axis direction,</p> <p>b) (EBY: roll); in the X-axis direction.</p> <p>When Y-axis motion causes an angular deviation of both spindle-head and the work-holding table, differential measurements of the two angular deviations shall be made, and this shall be stated.</p> <p>The reference level shall be located on the work-holding table and shall be in the middle of the travel range.</p> <p>Measurements shall be carried out in at least five equally spaced positions of a maximum distance of 1 000 mm, along the travel in both directions of movement.</p> <p>The difference between the maximum reading and the minimum reading of the two directions shall not exceed the tolerance.</p> | |