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# ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

# ISO RECOMMENDATION

# R 1984

## TEST CONDITIONS FOR MILLING MACHINES WITH TABLE OF FIXED HEIGHT WITH HORIZONTAL OR VERTICAL SPINDLE

## TESTING OF ACCURACY

1st EDITION
November 1971





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## BRIEF HISTORY

The ISO Recommendation R 1984, *Test conditions for milling machines with table of fixed height, with horizontal or vertical spindle – Testing of accuracy*, was drawn up by Technical Committee ISO/TC 39, *Machine tools*, the Secretariat of which is held by the Association Française de Normalisation (AFNOR).

Work on this question led to the adoption of Draft ISO Recommendation No. 1984, which was circulated to all the ISO Member Bodies for enquiry in June 1970. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

| | | |
|---|---|---|
| Belgium | India | South Africa, Rep. of |
| Chile | Italy | Spain |
| Czechoslovakia | Japan | Switzerland |
| France | Korea, Rep. of | Thailand |
| Germany | Netherlands | U.A.R. |
| Greece | New Zealand | United Kingdom |
| Hungary | Portugal | U.S.A. |

The following Member Body opposed the approval of the Draft :

Sweden

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 1984 November 1971

# TEST CONDITIONS FOR MILLING MACHINES WITH TABLE OF FIXED HEIGHT WITH HORIZONTAL OR VERTICAL SPINDLE

## TESTING OF ACCURACY



### 1. SCOPE

This ISO Recommendation describes, with reference to ISO Recommendation R 230, *Machine tool test code*, both geometrical and practical tests on general purpose and normal accuracy milling machines with table of fixed height, with horizontal or vertical spindle, and the corresponding permissible deviations which apply.

It deals only with the verification of accuracy of the machine. It does not apply to the testing of the running of the machine (vibrations, abnormal noises, stick-slip motion of components, etc.), or to machine characteristics (speeds, feeds, etc.), which should generally be checked before testing accuracy.

### 2. PRELIMINARY REMARKS

2.1 In this ISO Recommendation, all the dimensions are expressed in millimetres and in inches.

2.2 To apply this ISO Recommendation, reference should be made to ISO Recommendation R 230, especially for the installation of the machine before testing, warming up of spindles and other moving parts, description of measuring methods and recommended accuracy of testing equipment.

2.3 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and this in no way defines the practical order of testing. In order to make the mounting of instruments or gauging easier, tests may be applied in any order.

2.4 When inspecting a machine, it is not always necessary to carry out all the tests described in this ISO Recommendation. It is up to the user to choose, in agreement with the manufacturer, those tests relating to the properties which are of interest to him, but these tests are to be clearly stated when ordering a machine.

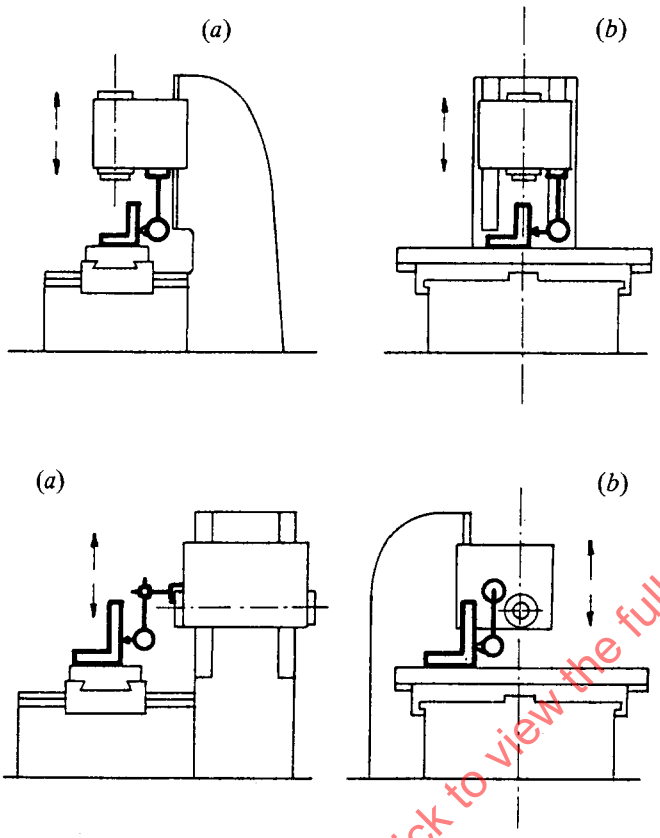
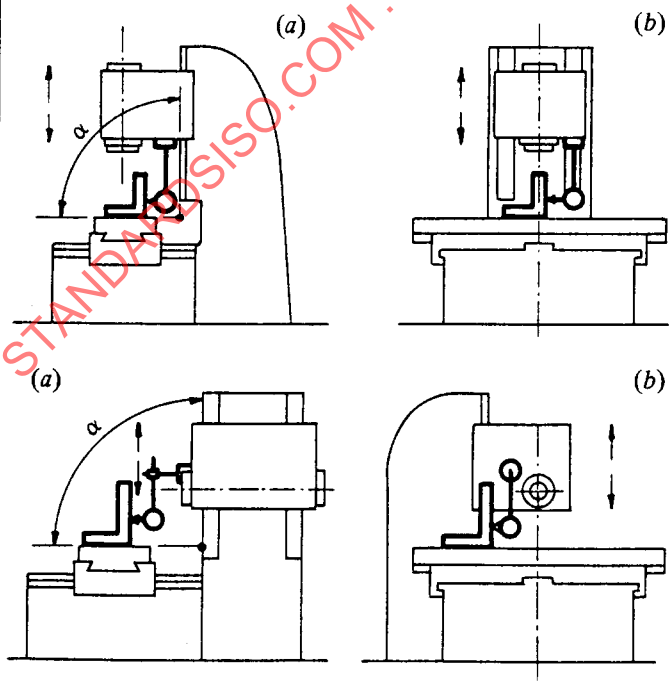
2.5 Practical tests should be made with finishing cuts – for example : depth = 0.1 mm (0.004 in), feed per tooth = 0.1 mm (0.004 in) – and not with roughing cuts which are liable to generate appreciable cutting forces.

2.6 When the tolerance is established for a measuring range different from that given in this ISO Recommendation (see clause 2.311 in ISO Recommendation R 230), it should be taken into consideration that the minimum value of tolerance is 0.01 mm (0.0004 in).

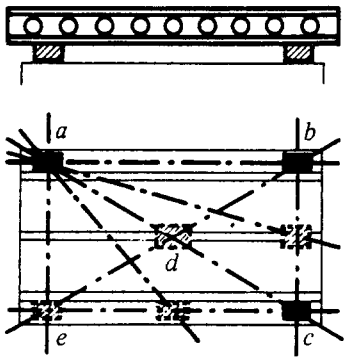
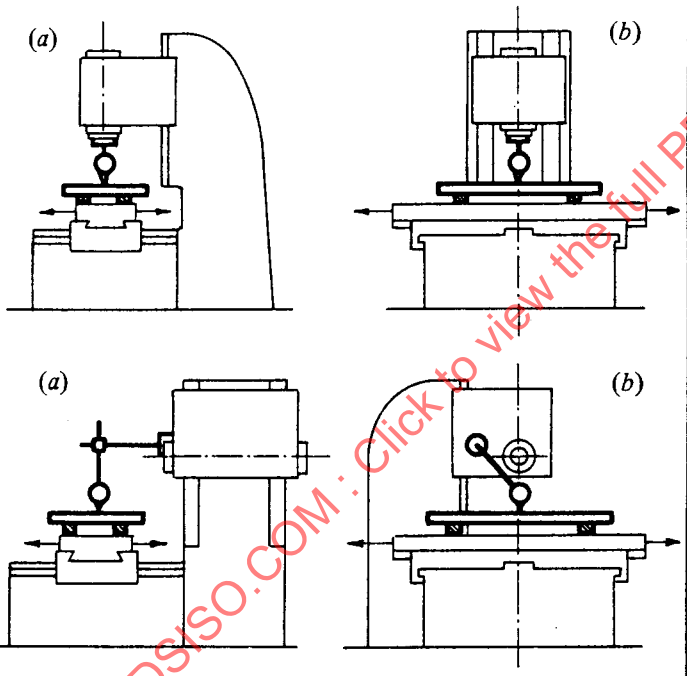
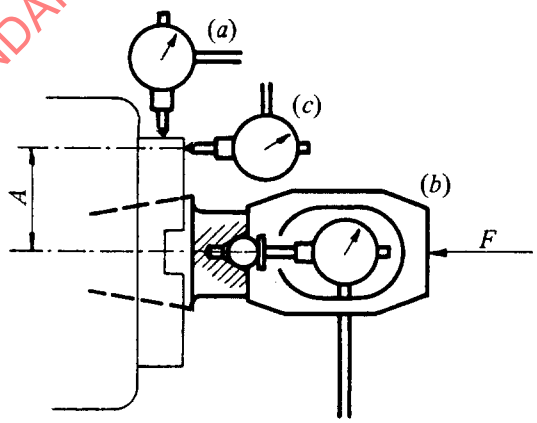
2.7 For reasons of simplicity, the diagrams in this ISO Recommendation illustrate only one type of machine.

## 3. TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

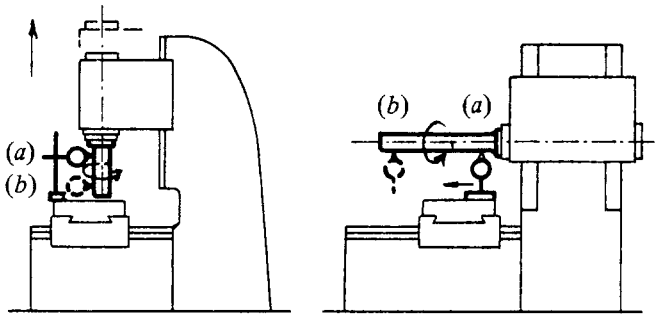
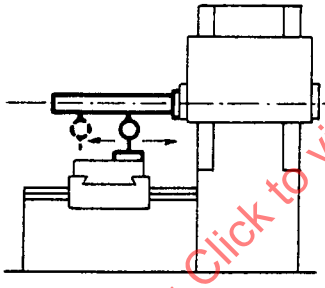
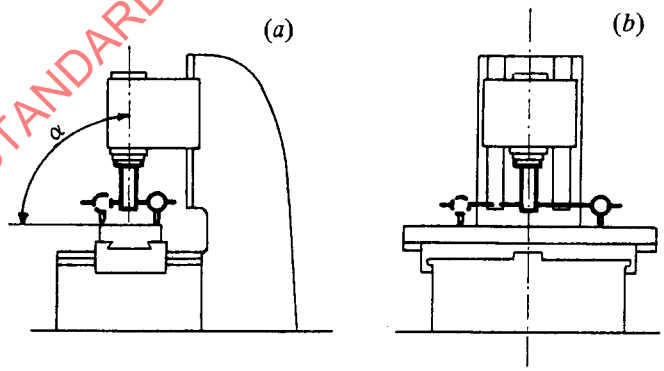
### 3.1 Geometrical tests

| No. | Diagram | Object |
|---|---|---|
| G 1 |  | Verification of straightness of the vertical movement of the spindle head slide :<br>(a) in the vertical plane of symmetry of the machine;<br>(b) in the plane perpendicular to the vertical plane of symmetry of the machine. |
| G 2 |  | Verification of squareness of the table surface to the vertical movement of the spindle head slide :<br>(a) in the vertical plane of symmetry of the machine;<br>(b) in the plane perpendicular to the vertical plane of symmetry of the machine. |

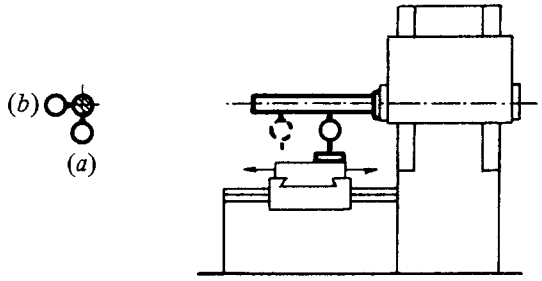
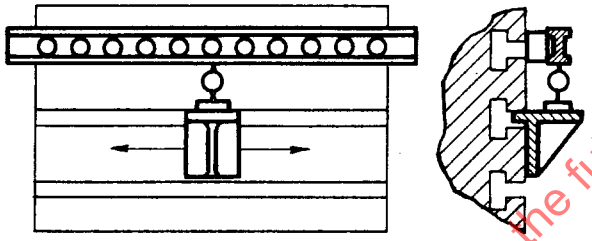
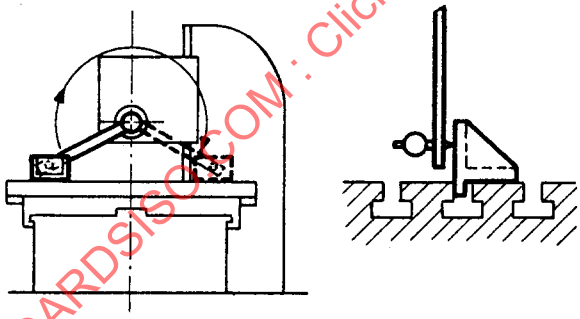
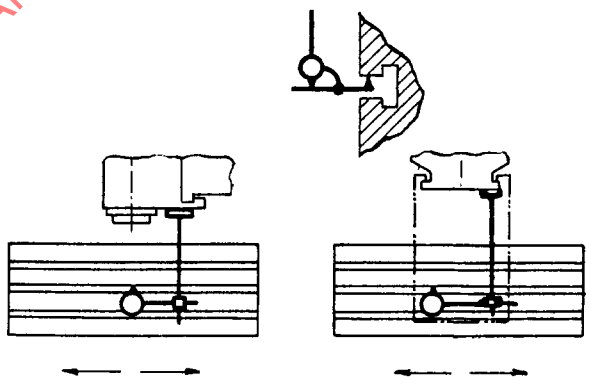
| Permissible deviation | | Measuring instruments | Observations and references to the test code ISO/R 230 |
|---|---|---|---|
| mm | in | | |
| (*a*) 0.025 for a measuring length of 300<br>(*b*) 0.025 for a measuring length of 300 | (*a*) 0.001 for a measuring length of 12<br>(*b*) 0.001 for a measuring length of 12 | Dial gauge and square | Clause 5.232.1<br>Instead of the straightedge specified in the test code ISO/R 230, use the vertical arm of a square.<br>Table in central position, table and cross slide locked.<br>If the spindle can be locked, the dial gauge may be mounted on it. If the spindle cannot be locked, the dial gauge should be placed on the spindle head of the machine. |
| (*a*) 0.025/300 with $\alpha \leqslant 90°$<br>(*b*) 0.025/300 | (*a*) 0.001/12 with $\alpha \leqslant 90°$<br>(*b*) 0.001/12 | Dial gauge and square | Clause 5.522.2<br>Table in central position, cross slide and table locked.<br>Spindle head slide locked when taking measurements.<br>If the spindle can be locked, the dial gauge may be mounted on it. If the spindle cannot be locked, the dial gauge should be placed on the spindle head of the machine. |

| No. | Diagram | Object |
|---|---|---|
| G 3 |  | Verification of flatness of the table surface. |
| G 4 |  | (*a*) Verification of parallelism of the table surface to the transverse movement of the table (or spindle);<br>(*b*) Verification of parallelism of the table surface to the longitudinal movement of the table. |
| G 5 |  | (*a*) Measurement of run-out of the external centring surface on the spindle nose (for machines having this feature).<br>(*b*) Measurement of periodic axial slip.<br>(*c*) Measurement of camming of the face of the spindle nose (including periodic axial slip). |

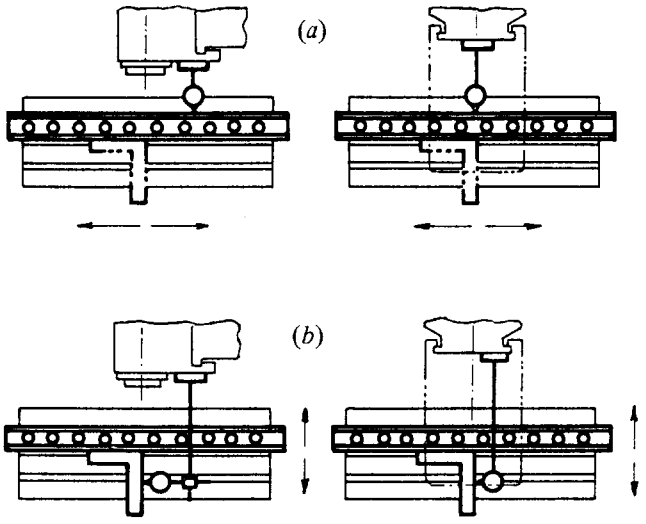
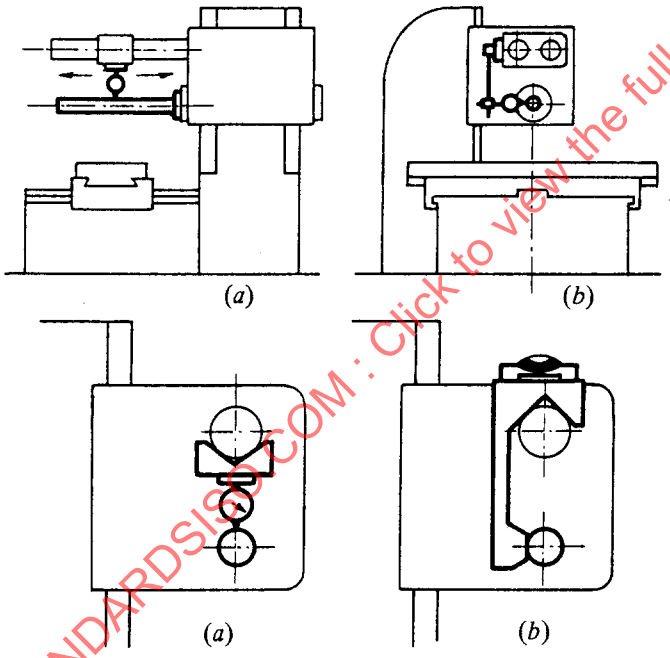
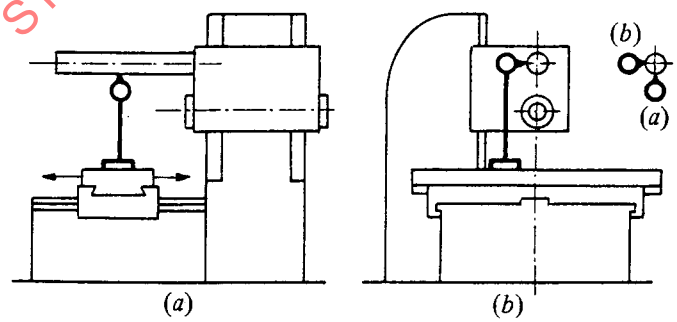
| Permissible deviation | | Measuring instruments | Observations and references to the test code ISO/R 230 |
|---|---|---|---|
| mm | in | | |
| 0.04 up to 1000<br>For each 1000 mm increase in length, add 0.005<br>Maximum permissible deviation :<br>0.05<br>Local tolerance :<br>0.02<br>for any measuring length of 300 | 0.0016 up to 40<br>For each 40 in increase in length, add 0.0002<br>Maximum permissible deviation :<br>0.002<br>Local tolerance :<br>0.0008<br>for any measuring length of 12 | Precision level or straightedge and slip gauges | Clauses 5.322 and 5.323<br>Table and cross slide in central position, table not locked, cross slide locked. |
| (*a*) 0.025 for any measuring length of 300<br>(*b*) 0.025 for any measuring length of 300<br>Maximum permissible deviation :<br>0.05 | (*a*) 0.001 for any measuring length of 12<br>(*b*) 0.001 for any measuring length of 12<br>Maximum permissible deviation :<br>0.002 | Straightedge and dial gauge | Clause 5.422.21<br>The stylus of the dial gauge to be placed approximately at the working position of the tool.<br>The measurement may be made on a straightedge laid parallel to the table surface.<br>If the table length is greater than 1600 mm (64 in), the inspection should be carried out by successive movements of the straightedge.<br>If the spindle can be locked, then after locking the spindle head slide, the dial gauge may be mounted on it. If the spindle cannot be locked, then the dial gauge should be placed on a fixed part of the machine.<br>(*a*) table and spindle head slide locked;<br>(*b*) cross slide and spindle head slide locked. |
| (*a*) 0.01<br>(*b*) 0.01<br>(*c*) 0.02 | (*a*) 0.0004<br>(*b*) 0.0004<br>(*c*) 0.0008 | Dial gauge | (*a*) Clause 5.612.2<br>(*b*) Clauses 5.622.1 and 5.622.2<br>A force $F$, specified by the manufacturer of the machine, should be exerted by pressing towards the housing for tests (*b*) and (*c*).<br>(*c*) Clause 5.632<br>The distance $A$ of dial gauge (*c*) from the spindle axis should be as large as possible. |

| No. | Diagram | Object |
|---|---|---|
| G 6 |  | Measurement of run-out of the internal taper of the spindle :<br>(*a*) near the mouth of taper;<br>(*b*) at a distance of 300 mm (12 in) from the spindle nose. |
| G 7 |  | Verification of parallelism of the spindle axis to the table surface. (This test applies to horizontal spindle machines only.) |
| G 8 |  | Verification of squareness of the spindle axis to the table surface. (This test applies to vertical spindle machines only.) :<br>(*a*) in the vertical plane of symmetry of the machine;<br>(*b*) in the plane perpendicular to the vertical plane of symmetry of the machine. |

| Permissible deviation | | Measuring instruments | Observations and references to the test code ISO/R 230 |
|---|---|---|---|
| mm | in | | |
| (*a*) 0.01<br>(*b*) 0.02 | (*a*) 0.0004<br>(*b*) 0.0008 | Dial gauge and test mandrel | Clause 5.612.3 |
| 0.025<br>for a measuring length of 300<br>(free end of the test mandrel inclined downwards) | 0.001<br>for a measuring length of 12<br>(free end of the test mandrel inclined downwards) | Dial gauge and test mandrel | Clause 5.412.4<br><br>Table and cross slide unlocked, spindle head slide locked. |
| (*a*) 0.025/300 with $\alpha \leqslant 90°$<br>(*b*) 0.025/300 | (*a*) 0.001/12 with $\alpha \leqslant 90°$<br>(*b*) 0.001/12 | Dial gauge | Clauses 5.512.1 and 5.512.42<br><br>Table, cross slide and spindle head slide locked. |

| No. | Diagram | Object |
|---|---|---|
| G 9 |  | Verification of parallelism of the spindle axis to the transverse movement of the table. (This test only applies to machines with transverse table movement.) :<br>(*a*) in the vertical plane;<br>(*b*) in the horizontal plane. |
| G 10 |  | Verification of straightness of the median or reference tee slot of the table. |
| G 11 |  | Verification of squareness of the spindle axis to the median or reference tee slot of the table. (This test applies to horizontal spindle machines only.) |
| G 12 |  | Verification of parallelism of the median or reference tee slot to the longitudinal movement of the table. |

| Permissible deviation | | Measuring instruments | Observations and references to the test code ISO/R 230 |
|---|---|---|---|
| mm | in | | |
| (*a*) 0.025 for a measuring length of 300 (free end of the test mandrel inclined downwards)<br>(*b*) 0.025 for a measuring length of 300 | (*a*) 0.001 for a measuring length of 12 (free end of the test mandrel inclined downwards)<br>(*b*) 0.001 for a measuring length of 12 | Dial gauge and test mandrel | Clause 5.422.3<br>Table in central position, spindle head slide locked. |
| 0.01 for any measuring length of 500<br>Maximum permissible deviation : 0.03 | 0.0004 for any measuring length of 20<br>Maximum permissible deviation : 0.0012 | Straightedge and dial gauge or slip gauges, or taut wire and microscope | Clauses 5.212, 5.212.1, 5.212.3 or 5.232<br>The straightedge may be placed directly on the table. |
| 0.02/300* | 0.0008/12* | Dial gauge | Clauses 5.512.1 and 5.512.52<br>Table in central position.<br>Table, cross slide and spindle head slide locked.<br>* Distance between the two points touched. |
| 0.015 for any measuring length of 300<br>Maximum permissible deviation : 0.04 | 0.0006 for any measuring length of 12<br>Maximum permissible deviation : 0.0016 | Dial gauge | Clauses 5.422.1 and 5.422.21<br>Cross slide and spindle head slide locked.<br>If the spindle can be locked, the dial gauge may be mounted on it. If the spindle cannot be locked then the dial gauge should be placed on a fixed part of the machine. |

| No. | Diagram | Object |
|---|---|---|
| G 13 |  | Verification of squareness of the transverse movement of the table (or spindle) to the longitudinal movement of the table. |
| G 14 |  | Verification of parallelism of arbor support guide on the over arm (or arms) to the spindle axis :<br>(a) in the vertical plane;<br>(b) in the horizontal plane. |
| | **Alternative**<br>  | Verification of parallelism of arbor support guide on the over arm (or arms) to the transverse movement of the table :<br>(a) in the vertical plane;<br>(b) in the horizontal plane. |

| Permissible deviation | | Measuring instruments | Observations and references to the test code ISO/R 230 |
|---|---|---|---|
| mm | in | | |
| 0.02/300 | 0.0008/12 | Straightedge, dial gauge and square | Clause 5.522.4<br>(*a*) The straightedge should be set parallel to the table longitudinal movement; then the square should be placed against the straightedge. The table should then be locked in central position.<br>(*b*) The table transverse movement should then be checked.<br>If the spindle can be locked, then after locking the spindle head slide, the dial gauge may be mounted on it. If the spindle cannot be locked then the dial gauge should be placed on a fixed part of the machine. |
| (*a*) 0.02 for a measuring length of 300 (over arm inclined downwards)<br>(*b*) 0.02 for a measuring length of 300 | (*a*) 0.0008 for a measuring length of 12 (over arm inclined downwards)<br>(*b*) 0.0008 for a measuring length of 12 | Dial gauge and possibly precision level | Clause 5.412.5<br>or<br>clauses 5.412.1 and 5.412.3<br>Clause 5.422.4<br>Over arm(s) locked. |
| (*a*) 0.02 for a measuring length of 300 (over arm inclined downwards)<br>(*b*) 0.02 for a measuring length of 300 | (*a*) 0.0008 for a measuring length of 12 (over arm inclined downwards)<br>(*b*) 0.0008 for a measuring length of 12 | | |