

# ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

## ISO RECOMMENDATION R 1701

TEST CONDITIONS FOR MILLING MACHINES  
WITH TABLE OF VARIABLE HEIGHT,  
WITH HORIZONTAL OR VERTICAL SPINDLE

TESTING OF THE ACCURACY

1st EDITION

April 1970

COPYRIGHT RESERVED

The copyright of ISO Recommendations and ISO Standards belongs to ISO Member Bodies. Reproduction of these documents, in any country, may be authorized therefore only by the national standards organization of that country, being a member of ISO.

For each individual country the only valid standard is the national standard of that country.

Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations.

STANDARDSISO.COM : Click to view the full PDF of ISO/R 1701:1970

## BRIEF HISTORY

The ISO Recommendation R 1701, *Test conditions for milling machines with table of variable height, with horizontal or vertical spindle – Testing of the 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. 1701 which was circulated to all the ISO Member Bodies for enquiry in August 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

|                |                       |                |
|----------------|-----------------------|----------------|
| Australia      | India                 | Spain          |
| Belgium        | Iran                  | Sweden         |
| Brazil         | Israel                | Switzerland    |
| Czechoslovakia | Italy                 | Thailand       |
| Finland        | Korea, Rep. of        | Turkey         |
| France         | Netherlands           | U.A.R.         |
| Germany        | New Zealand           | United Kingdom |
| Greece         | Romania               |                |
| Hungary        | South Africa, Rep. of |                |

The following Member Body opposed the approval of the Draft :

Japan

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in April 1970, to accept it as an ISO RECOMMENDATION.

## CONTENTS

|                                                                           | Page |
|---------------------------------------------------------------------------|------|
| 1. Scope . . . . .                                                        | 5    |
| 2. Preliminary remarks . . . . .                                          | 5    |
| 3. Test conditions and permissible deviations (Dimensions in millimetres) |      |
| 3.1 Geometrical tests . . . . .                                           | 7    |
| 3.2 Practical test . . . . .                                              | 19   |
| 4. Test conditions and permissible deviations (Dimensions in inches)      |      |
| 4.1 Geometrical tests . . . . .                                           | 21   |
| 4.2 Practical test . . . . .                                              | 33   |

STANDARDSISO.COM : Click to view the full PDF of ISO/R 1701:1970

**TEST CONDITIONS FOR MILLING MACHINES**  
**WITH TABLE OF VARIABLE HEIGHT,**  
**WITH HORIZONTAL OR VERTICAL SPINDLE**  
**TESTING OF THE ACCURACY**

**1. SCOPE**

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

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

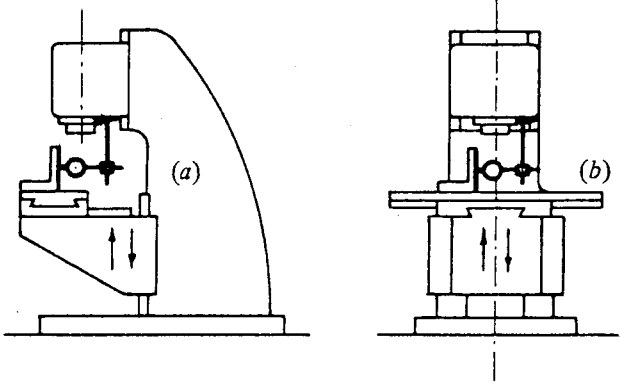
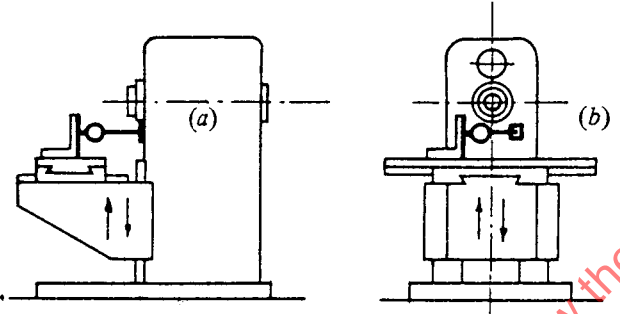
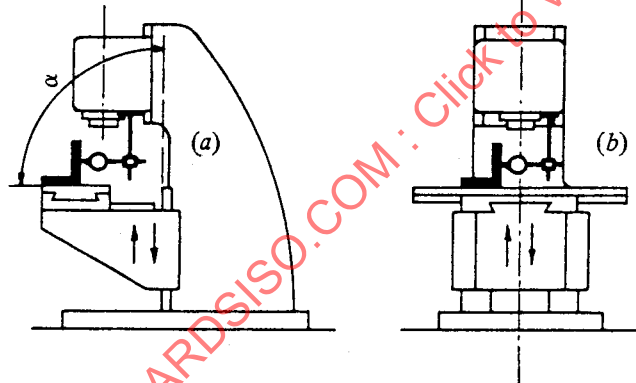
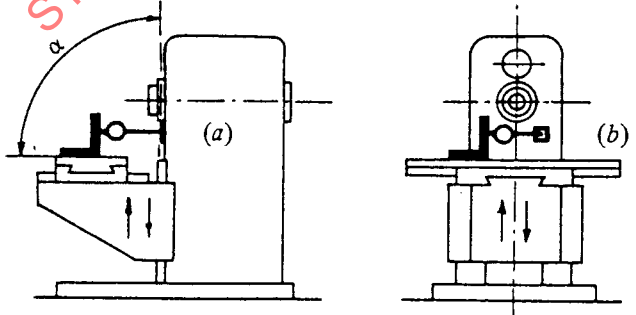
**2. PRELIMINARY REMARKS**

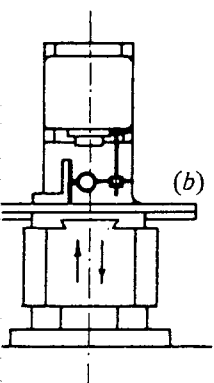
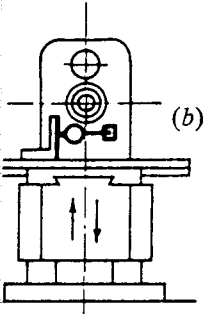
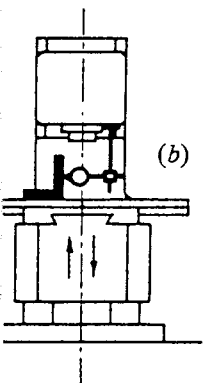
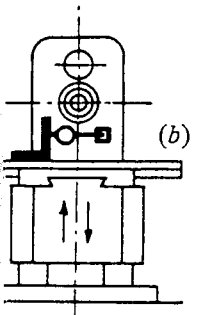
- 2.1 In this ISO Recommendation, all the dimensions are expressed in millimetres in section 3 and in inches in section 4.
- 2.2 To apply this ISO Recommendation, reference should be made to ISO Recommendation R 230, especially for the installation of the machine before testing, warming up of spindles 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 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 instance : 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 establishing the tolerance 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).

STANDARDSISO.COM : Click to view the full PDF of ISO/R 1701:1970

### 3. TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

#### 3.1 Geometrical tests

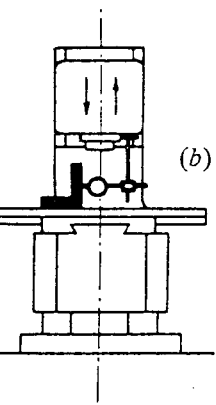
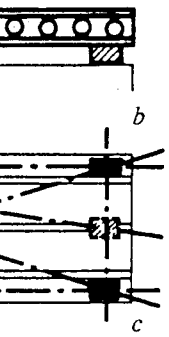
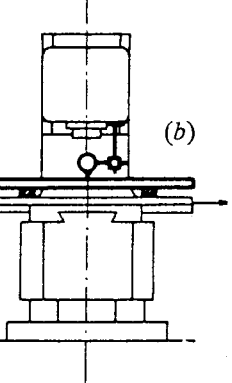
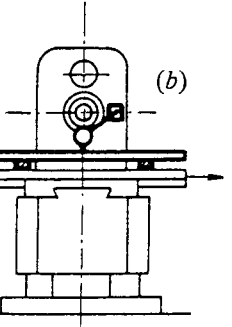
| No. | Diagram                                                                                                                                                                    | Object                                                                                                                                                                                                                                                                                                                                                                      |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 1 | <br>    | <p>Checking of straightness of the vertical movement of the knee :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p>                                                                                       |
| G 2 | <br> | <p>Checking of squareness of the table surface to the column ways for knee (in three positions : in the middle and near the extremities of the travel) :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> |

|                                                                                                                                                                        | Object                                                                                                                                                                                                                                                                                                                                                                      | Permissible deviation                                                                                 | Measuring instrument: |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------|
| <br>    | <p>Checking of straightness of the vertical movement of the knee :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p>                                                                                       | <p>(a) 0.025<br/>for a measuring length of 300</p> <p>(b) 0.025<br/>for a measuring length of 300</p> | Dial gauge and square |
| <br> | <p>Checking of squareness of the table surface to the column ways for knee (in three positions : in the middle and near the extremities of the travel) :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> | <p>(a) 0.025/300<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.025/300</p>                  | Dial gauge and square |

Dimensions in millimetres

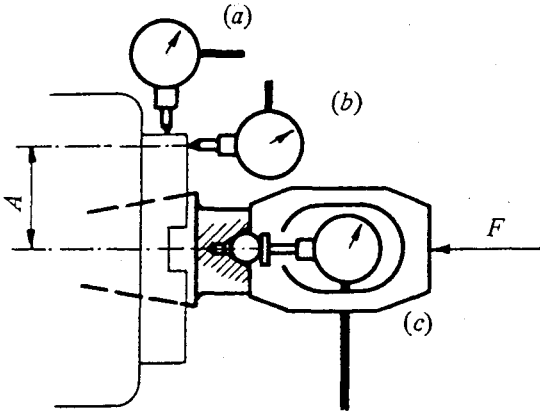
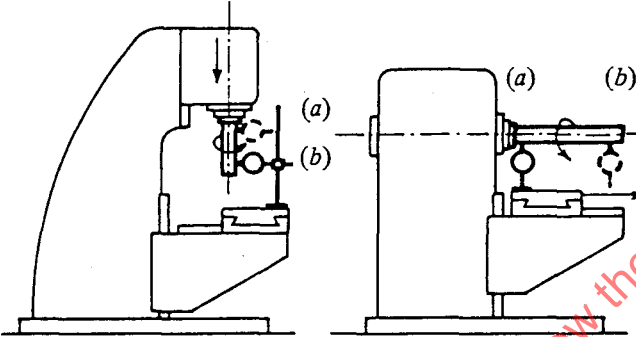
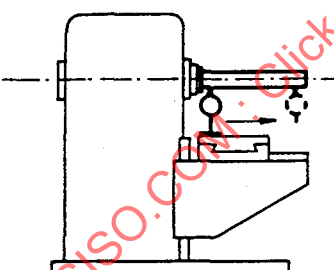
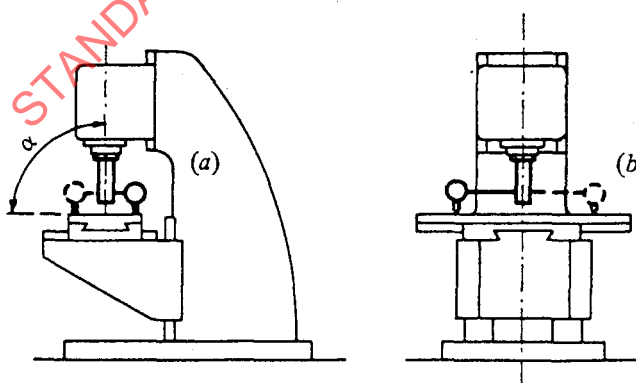
|                                                                                                                                                          | Permissible deviation                                                                                         | Measuring instruments | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>vertical move-</p> <p>symmetry of the<br/>tical plane;</p> <p>ar to the vertical<br/>the machine or</p>                                               | <p>(a) 0.025<br/>for a measuring length<br/>of 300</p> <p>(b) 0.025<br/>for a measuring length<br/>of 300</p> | Dial gauge and square | <p>Clause 5.232.1</p> <p>Instead of a straightedge, use the vertical arm of a square.</p> <p>Table in central position, table and cross slide locked, knee not locked.</p> <p>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 a fixed part of the machine.</p> |
| <p>table surface to<br/>three positions :<br/>extremities of the</p> <p>ymmetry of the<br/>tical plane;</p> <p>ar to the vertical<br/>the machine or</p> | <p>(a) 0.025/300<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.025/300</p>                          | Dial gauge and square | <p>Clause 5.522.2</p> <p>Table in central position, table and cross slide locked.</p> <p>Knee locked when taking measurements.</p> <p>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 a fixed part of the machine.</p>                                         |

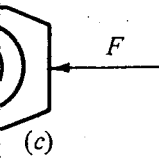
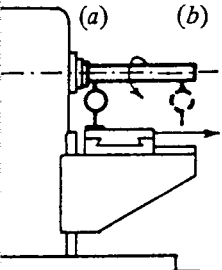
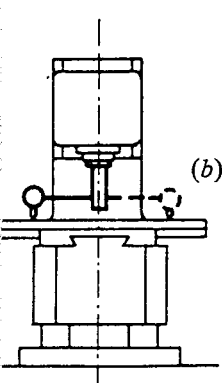
| No. | Diagram | Object                                                                                                                                                                                                                                                                                                                 |
|-----|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 3 |         | <p>Checking of squareness of the table surface to the vertical movement of the spindle head slide :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> |
| G 4 |         | <p>Checking of flatness of the table surface.</p>                                                                                                                                                                                                                                                                      |
| G 5 |         | <p>Checking of parallelism of the table surface to its movement :</p> <p>(a) transversely;</p> <p>(b) longitudinally.</p>                                                                                                                                                                                              |

|                                                                                                                                                                          | Object                                                                                                                                                                                                                                                                                                                 | Permissible deviation                                                                                                                                                          | Measuring instrument                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
|                                                                                          | <p>Checking of squareness of the table surface to the vertical movement of the spindle head slide :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> | <p>(a) 0.025/300<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.025/300</p>                                                                                           | Dial gauge and square                            |
|                                                                                         | <p>Checking of flatness of the table surface.</p>                                                                                                                                                                                                                                                                      | <p>0.04 up to 1 000</p> <p>For each 1 000 increase in table length, add 0.005</p> <p>Maximum permissible deviation : 0.05</p> <p>Local tolerance : 0.02 for any 300 length</p> | Precision level or straight edge and slip gauges |
| <br> | <p>Checking of parallelism of the table surface to its movement :</p> <p>(a) transversely;</p> <p>(b) longitudinally.</p>                                                                                                                                                                                              | <p>(a) 0.025<br/>for any 300 length</p> <p>(b) 0.025<br/>for any 300 length</p> <p>Maximum permissible deviation : 0.05</p>                                                    | Straightedge and dial gauge                      |

Dimensions in millimetres

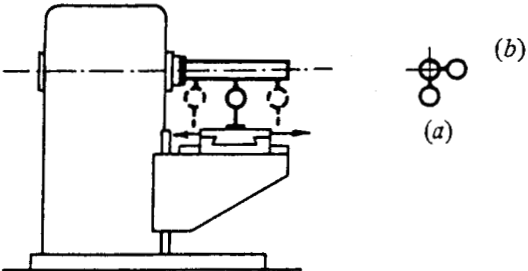
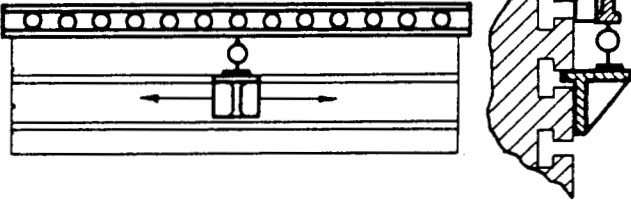
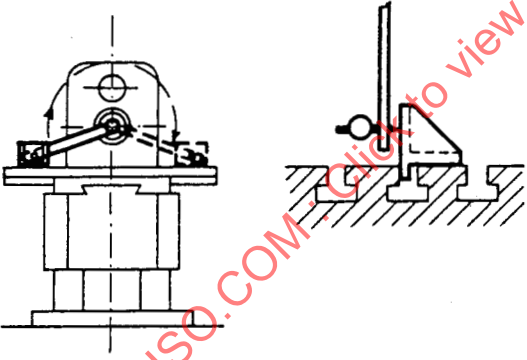
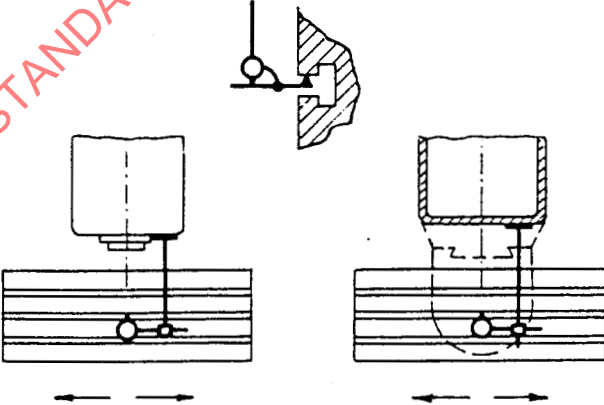
|                                                                                                                                                 | Permissible deviation                                                                                                                                                                               | Measuring instruments                            | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>the table surface to spindle head slide :</p> <p>symmetry of the vertical plane;</p> <p>parallel to the vertical plane of the machine or</p> | <p>(a) 0.025/300<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.025/300</p>                                                                                                                | Dial gauge and square                            | <p>Clause 5.522.2</p> <p>Table in central position, knee and table locked.</p> <p>Spindle head slide locked when taking measurements.</p> <p>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 slide of the machine.</p>                                                                                                                                                                                                                                                                                                                       |
| the table surface.                                                                                                                              | <p>0.04 up to 1 000</p> <p>For each 1 000 increase in table length, add 0.005</p> <p>Maximum permissible deviation :</p> <p>0.05</p> <p>Local tolerance :</p> <p>0.02</p> <p>for any 300 length</p> | Precision level or straight-edge and slip gauges | <p>Clauses 5.322 and 5.323</p> <p>Table and cross slide in central position, table not locked, knee and cross slide locked.</p> <p>NOTE. – The alphabetical references on the diagram correspond to those used in Figure 19 of ISO Recommendation R 230.</p>                                                                                                                                                                                                                                                                                                                                                                                        |
| the table surface to                                                                                                                            | <p>(a) 0.025<br/>for any 300 length</p> <p>(b) 0.025<br/>for any 300 length</p> <p>Maximum permissible deviation :</p> <p>0.05</p>                                                                  | Straightedge and dial gauge                      | <p>Clause 5.422.21</p> <p>The stylus of the dial gauge to be placed approximately at the working position of the tool.</p> <p>The measurement may be made on a straight-edge laid parallel to the table surface.</p> <p>If the table length is greater than 1600 mm, carry out the inspection by successive movements of the straightedge.</p> <p>Knee locked.</p> <p>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 a fixed part of the machine.</p> <p>(a) Table and spindle head slide locked;</p> <p>(b) Cross slide and spindle head slide locked.</p> |

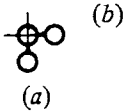
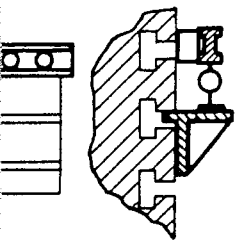
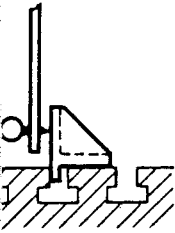
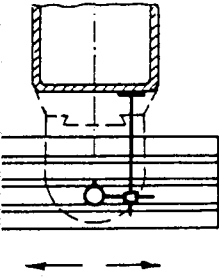
| No. | Diagram                                                                             | Object                                                                                                                                                                                                                                                                                  |
|-----|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 6 |    | <p>(a) Measurement of run-out of the external centring surface on the spindle nose (for machines having this feature).</p> <p>(b) Measurement of camming of the face of the spindle nose (including periodic axial slip).</p> <p>(c) Measurement of periodic axial slip.</p>            |
| G 7 |   | <p>Measurement of run-out of the internal taper of the spindle :</p> <p>(a) at the mouth of taper;</p> <p>(b) at a distance of 300 from the spindle nose.</p>                                                                                                                           |
| G 8 |  | <p>Checking of parallelism of the spindle axis to the table surface.</p>                                                                                                                                                                                                                |
| G 9 |  | <p>Checking of squareness of the spindle axis to the table surface :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> |

|                                                                                                 | Object                                                                                                                                                                                                                                                                                  | Permissible deviation                                                                                      | Measuring instrument     |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------|
|  <p>(c)</p>      | <p>(a) Measurement of run-out of the external centring surface on the spindle nose (for machines having this feature).</p> <p>(b) Measurement of camming of the face of the spindle nose (including periodic axial slip).</p> <p>(c) Measurement of periodic axial slip.</p>            | <p>(a) 0.01</p> <p>(b) 0.02</p> <p>(c) 0.01</p>                                                            | Dial gauge               |
|  <p>(a) (b)</p> | <p>Measurement of run-out of the internal taper of the spindle :</p> <p>(a) at the mouth of taper;</p> <p>(b) at a distance of 300 from the spindle nose.</p>                                                                                                                           | <p>(a) 0.01</p> <p>(b) 0.02</p>                                                                            | Dial gauge and test mand |
|                 | <p>Checking of parallelism of the spindle axis to the table surface.</p>                                                                                                                                                                                                                | <p>0.025</p> <p>for a measuring length of 300 (free end of the test mandrel inclined downwards)</p>        | Dial gauge and test mand |
|  <p>(b)</p>    | <p>Checking of squareness of the spindle axis to the table surface :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> | <p>(a) <math>0.025/300</math> with <math>\alpha \leq 90^\circ</math></p> <p>(b) <math>0.025/300</math></p> | Dial gauge               |

Dimensions in millimetres

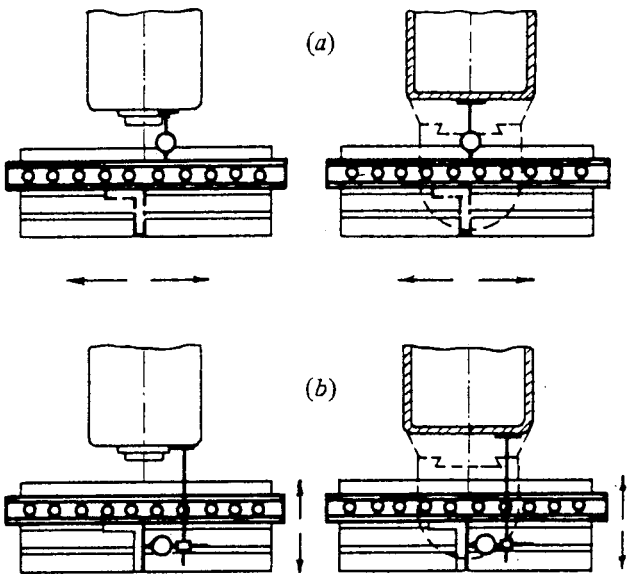
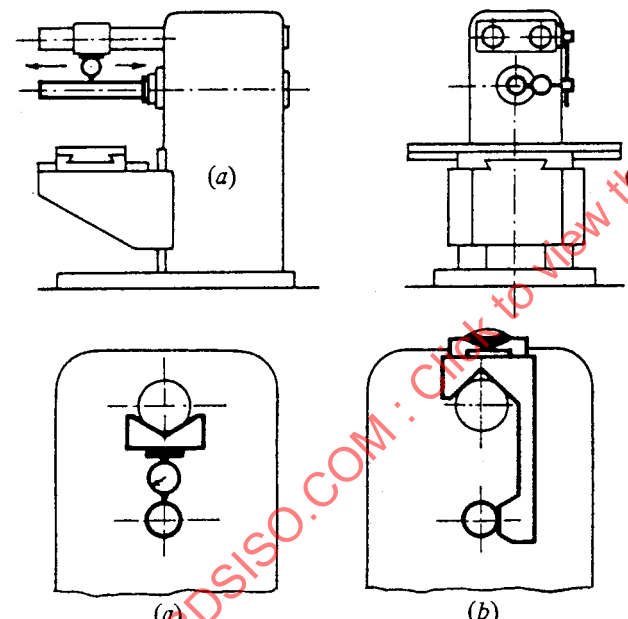
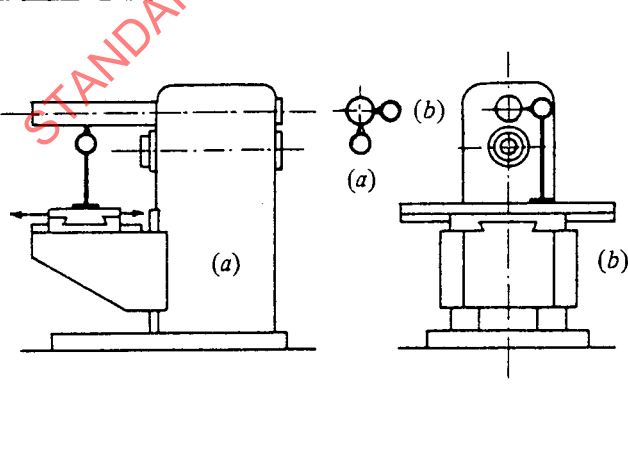
|                                                                                                                     | Permissible deviation                                                                                       | Measuring instruments       | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>t of the external spindle nose (for ture).</p> <p>ng of the face of ling periodic axial</p> <p>c axial slip.</p> | <p>(a) 0.01</p> <p>(b) 0.02</p> <p>(c) 0.01</p>                                                             | Dial gauge                  | <p>(a) Clause 5.612.2</p> <p>(b) Clause 5.632<br/>The distance <math>A</math> of dial gauge (b) from the spindle axis should be as large as possible.</p> <p>(c) Clauses 5.662.1 and 5.622.2<br/>A force <math>F</math>, specified by the manufacturer of the machine, should be exerted by pressing towards the housing for tests (b) and (c).</p> |
| <p>the internal taper</p> <p>from the spindle</p>                                                                   | <p>(a) 0.01</p> <p>(b) 0.02</p>                                                                             | Dial gauge and test mandrel | Clause 5.612.3                                                                                                                                                                                                                                                                                                                                      |
| the spindle axis                                                                                                    | <p>0.025</p> <p>for a measuring length of 300<br/>(free end of the test mandrel<br/>inclined downwards)</p> | Dial gauge and test mandrel | <p>Clause 5.412.4.</p> <p>Table and cross slide not locked, knee locked.</p>                                                                                                                                                                                                                                                                        |
| <p>spindle axis to the</p> <p>symmetry of the<br/>rtical plane;</p> <p>ar to the vertical<br/>the machine or</p>    | <p>(a) 0.025/300<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.025/300</p>                        | Dial gauge                  | <p>Clauses 5.512.1 and 5.512.42</p> <p>Spindle head slide, table, cross slide and knee locked.</p>                                                                                                                                                                                                                                                  |

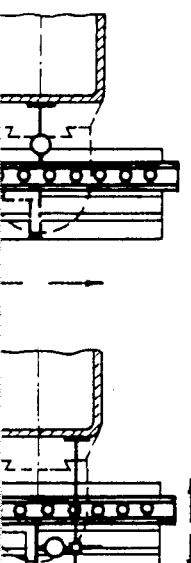
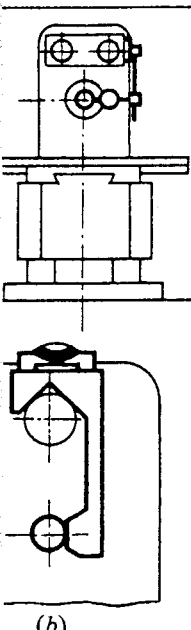
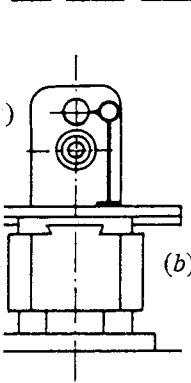
| No.  | Diagram                                                                             | Object                                                                                                                                                             |
|------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 10 |    | <p>Checking of parallelism of the spindle axis to the transverse movement of the table :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p> |
| G 11 |    | <p>Checking of straightness of the median or reference tee slot of the table.</p>                                                                                  |
| G 12 |  | <p>Checking of squareness of the spindle axis to the median or reference tee slot of the table.</p>                                                                |
| G 13 |  | <p>Checking of parallelism of the median or reference tee slot to the longitudinal movement of the table.</p>                                                      |

|                                                                                   | Object                                                                                                                                                             | Permissible deviation                                                                                                                                       | Measuring instrument                                                    |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
|   | <p>Checking of parallelism of the spindle axis to the transverse movement of the table :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p> | <p>(a) 0.025<br/>for a measuring length of 300<br/>(free end of the test mandrel inclined downwards)</p> <p>(b) 0.025<br/>for a measuring length of 300</p> | Dial gauge and test mandrel                                             |
|    | <p>Checking of straightness of the median or reference tee slot of the table.</p>                                                                                  | <p>0.01<br/>for any 500 length<br/>Maximum permissible deviation :<br/>0.03</p>                                                                             | Straightedge and dial gauge or slip gauges, or taut wire and microscope |
|  | <p>Checking of squareness of the spindle axis to the median or reference tee slot of the table.</p>                                                                | 0.02/300 *                                                                                                                                                  | Dial gauge                                                              |
|  | <p>Checking of parallelism of the median or reference tee slot to the longitudinal movement of the table.</p>                                                      | <p>0.015<br/>for any 300 length<br/>Maximum permissible deviation :<br/>0.04</p>                                                                            | Dial gauge                                                              |

Dimensions in millimetres

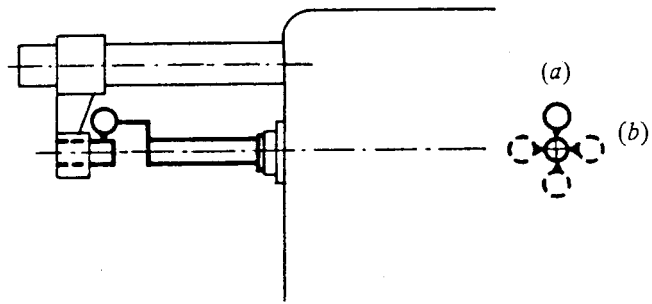
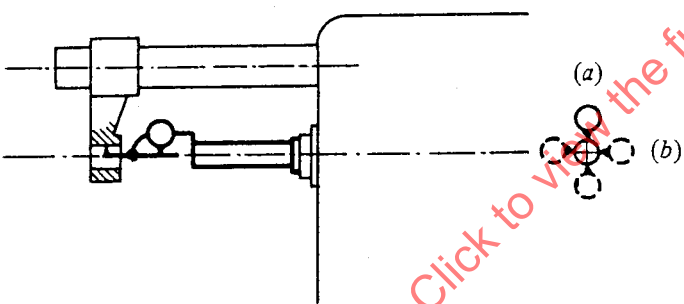
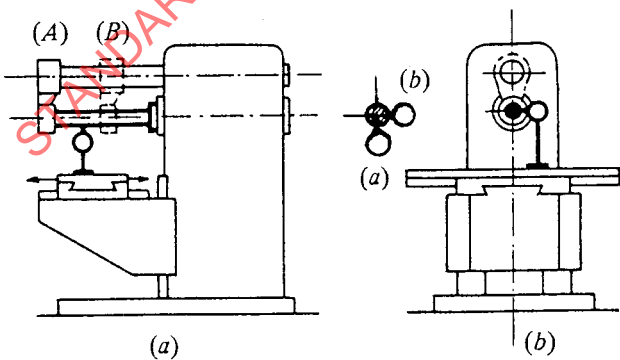
|                                         | Permissible deviation                                                                                                                                                         | Measuring instruments                                                         | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                      |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| spindle axis to the<br>table :          | <p>(a) 0.025<br/>for a measuring length<br/>of 300<br/>(free end of the test<br/>mandrel inclined down-<br/>wards)</p> <p>(b) 0.025<br/>for a measuring length<br/>of 300</p> | Dial gauge and test mandrel                                                   | <p>Clause 5.422.3.</p> <p>Table in central position.</p> <p>Knee locked.</p>                                                                                                                                                                                   |
| f the median or                         | <p>0.01<br/>for any 500 length</p> <p>Maximum permissible devi-<br/>ation :</p> <p>0.03</p>                                                                                   | Straightedge and dial gauge<br>or slip gauges, or taut wire<br>and microscope | <p>Clauses 5.212, 5.212.1, 5.212.3 or 5.232</p> <p>The straightedge may be placed directly on the<br/>table</p>                                                                                                                                                |
| spindle axis to the<br>ot of the table. | 0.02/300 *                                                                                                                                                                    | Dial gauge                                                                    | <p>Clauses 5.512.1 and 5.512.52</p> <p>Table in central position.</p> <p>Table, cross slide and knee locked.</p> <p>* Distance between the two points touched.</p>                                                                                             |
| e median or refer-<br>inal movement of  | <p>0.015<br/>for any 300 length</p> <p>Maximum permissible devi-<br/>ation :</p> <p>0.04</p>                                                                                  | Dial gauge                                                                    | <p>Clauses 5.422.1 and 5.422.21</p> <p>Cross slide and knee locked.</p> <p>If the spindle can be locked, the dial gauge may<br/>be mounted on it. If the spindle cannot be<br/>locked, the dial gauge should be placed on a<br/>fixed part of the machine.</p> |

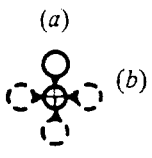
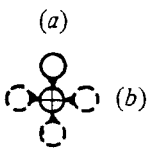
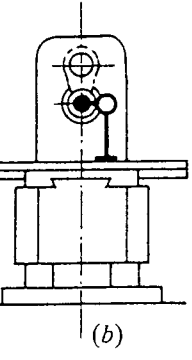
| No.  | Diagram                                                                                                                            | Object                                                                                                                                                                                          |
|------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 14 |                                                   | <p>Checking of squareness of the movement of the table transversely to its longitudinal movement.</p>                                                                                           |
| G 15 |                                                  | <p>Checking of parallelism of arbor support guide on the over arm (or arms) to the spindle axis :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p>                     |
|      | <p style="text-align: center;">Alternative</p>  | <p>Checking of parallelism of arbor support guide on the over arm (or arms) to the transverse movement of the table :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p> |

|                                                                                   | Object                                                                                                                                                                                                             | Permissible deviation                                                                                                                 | Measuring instruments               |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
|    | <p>Checking of squareness of the movement of the table transversely to its longitudinal movement.</p>                                                                                                              | 0.02/300                                                                                                                              | Straightedge, dial gauge and square |
|   | <p>Checking of parallelism of arbor support guide on the over arm (or arms) to the spindle axis :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p>                                        | <p>(a) 0.02<br/>for a measuring length of 300<br/>(over arm inclined downwards)</p> <p>(b) 0.02<br/>for a measuring length of 300</p> | Dial gauge and precision level.     |
|  | <p>Alternative</p> <p>Checking of parallelism of arbor support guide on the over arm (or arms) to the transverse movement of the table :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p> | <p>(a) 0.02<br/>for a measuring length of 300<br/>(over arm inclined downwards)</p> <p>(b) 0.02<br/>for a measuring length of 300</p> |                                     |

Dimensions in millimetres

|                                   | Permissible deviation                                                                                                                             | Measuring instruments                  | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| movement of the<br>spindle axis : | 0.02/300                                                                                                                                          | Straightedge, dial gauge<br>and square | <p>Clause 5.522.4</p> <p>Knee locked.</p> <p>(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.</p> <p>(b) The transverse movement of the table should then be checked.</p> <p>If the spindle can be locked, then the dial gauge may be mounted on it after locking the spindle head slide. If the spindle cannot be locked the dial gauge should be placed on a fixed part of the machine.</p> |
| support guide<br>spindle axis :   | <p>(a) 0.02<br/>for a measuring length<br/>of 300<br/>(over arm inclined<br/>downwards)</p> <p>(b) 0.02<br/>for a measuring length<br/>of 300</p> | Dial gauge and precision<br>level.     | <p>Clause 5.412.5</p> <p>or</p> <p>Clauses 5.412.3 and 5.412.1</p> <p>Clause 5.422.4.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| support guide<br>the transverse   | <p>(a) 0.02<br/>for a measuring length<br/>of 300<br/>(over arm inclined<br/>downwards)</p> <p>(b) 0.02<br/>for a measuring length<br/>of 300</p> |                                        | Over arm(s) locked.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

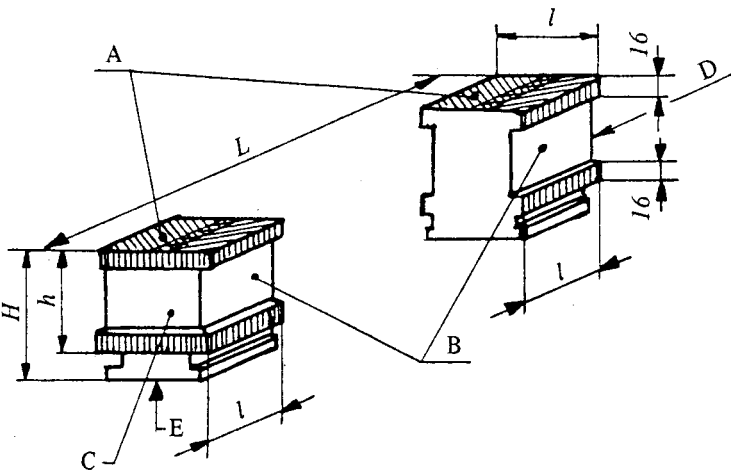
| No.  | Diagram                                                                                                                                     | Object                                                                                                                                                                                                                                                               |
|------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 16 |                                                            |                                                                                                                                                                                                                                                                      |
|      | <p>First alternative</p>      | <p>Checking of coincidence of the axis of the bore of the arbor support with the spindle axis :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p> |
|      | <p>Second alternative</p>  |                                                                                                                                                                                                                                                                      |

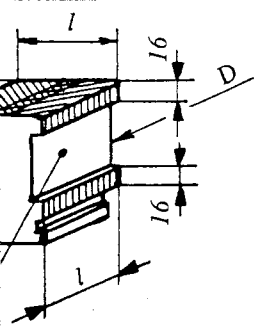
|                                                                                     | Object                                                                                                                                                                    | Permissible deviation                                                                                                                                                                                               | Measuring instruments       |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
|    |                                                                                                                                                                           |                                                                                                                                                                                                                     |                             |
|  | <p>Checking of coincidence of the axis of the bore of the arbor support with the spindle axis :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p> | <p>(a) 0.03<br/>(Axis of the bore of the arbor support lower than the spindle axis)</p> <p>(b) 0.03</p>                                                                                                             | Dial gauge and test mandrel |
|   |                                                                                                                                                                           | <p><b>Second alternative</b></p> <p>(a) 0.04<br/>for a measuring length of 300<br/>(Mandrel inclined downwards on the side of the bore of the arbor support)</p> <p>(b) 0.025<br/>for a measuring length of 300</p> |                             |

Dimensions in millimetres

|                                    | Permissible deviation                                                                                                                                                                                                                   | Measuring instruments       | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                                                                           |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| axis of the bore<br>spindle axis : | (a) 0.03<br>(Axis of the bore of the<br>arbor support lower<br>than the spindle axis)                                                                                                                                                   | Dial gauge and test mandrel | <p>Clauses 5.422.4 and 5.442</p> <p>Arbor support located 300 away from the spindle nose.</p> <p>The measurement should be made as near as possible to the arbor support.</p> <p>Over arm locked and arbor support not connected to the knee.</p>                                                                   |
|                                    | (b) 0.03                                                                                                                                                                                                                                |                             | <p><b>First alternative</b></p> <p>It is unnecessary to follow the test code ISO/R 230.</p> <p>The dial gauge is mounted on the spindle and the stylus touches the bore of the arbor support.</p> <p>The reading observed on the dial gauge must be divided by 2 for comparison with the permissible deviation.</p> |
|                                    | <p><b>Second alternative</b></p> <p>(a) 0.04<br/>for a measuring length<br/>of 300<br/>(Mandrel inclined<br/>downwards on the side<br/>of the bore of the arbor<br/>support)</p> <p>(b) 0.025<br/>for a measuring length<br/>of 300</p> |                             | <p><b>Second alternative</b></p> <p>(A) The end of the mandrel or cutter arbor is held by the arbor support.</p> <p>(B) The arbor support is positioned mid-way along the mandrel or cutter arbor.</p> <p>The reading observed on the dial gauge must not be divided by 2.</p>                                      |

### 3.2 Practical test

| No. | Diagram and test piece dimensions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Nature of test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Cutting conditions                                                                                                                    |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| P 1 |  <p><math>L</math> (length of the test piece or distance between the opposite faces of two test pieces)</p> <p><math>= \frac{1}{2}</math> longitudinal travel</p> <p><math>l = h = \frac{1}{8}</math> longitudinal travel</p> <p><math>l \text{ max.} = 100 \text{ for } L \leq 500</math><br/> <math>150 \text{ for } 500 &lt; L \leq 1000</math><br/> <math>200 \text{ for } L &gt; 1000</math></p> <p><math>l \text{ min.} = 50</math></p> <p>NOTES (concerning vertical and horizontal milling machines)</p> <ol style="list-style-type: none"> <li>1. Longitudinal travels <math>\geq 400</math> : one or two test pieces can be used and they should be machined in the longitudinal direction over a length <math>l</math> at each end.</li> <li>2. Longitudinal travels <math>&lt; 400</math> : one test piece is used and it should be machined over its entire length.</li> <li>3. Material : cast iron.</li> </ol> | <p><b>A Vertical milling machines</b></p> <p>Milling of surface A by automatic longitudinal movement of the table and manual transverse movement of the cross slide, in two cuts overlapping by about 5 to 10 mm.</p> <p>Milling of strips of surfaces B, C and D by automatic longitudinal movement of the table, automatic transverse movement of the cross slide and manual vertical movement of the knee.</p> <p><b>B Horizontal milling machines</b></p> <p>Milling of surface B by automatic longitudinal movement of the table and manual vertical movement of the knee, in two cuts overlapping by about 5 to 10 mm.</p> <p>Milling of strips of surfaces A, C and D by automatic longitudinal movement of the table, automatic vertical movement of the knee and manual transverse movement of the cross slide.</p> | <p>With a standard end mill.</p> <p>Slab mill with the cutter.</p> <p>With a standard end mill.</p> <p>Slab mill with the cutter.</p> |

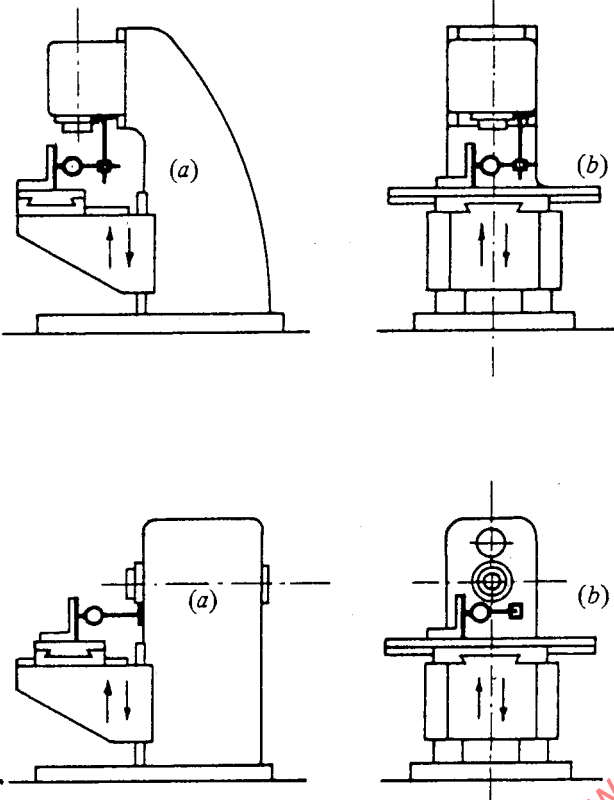
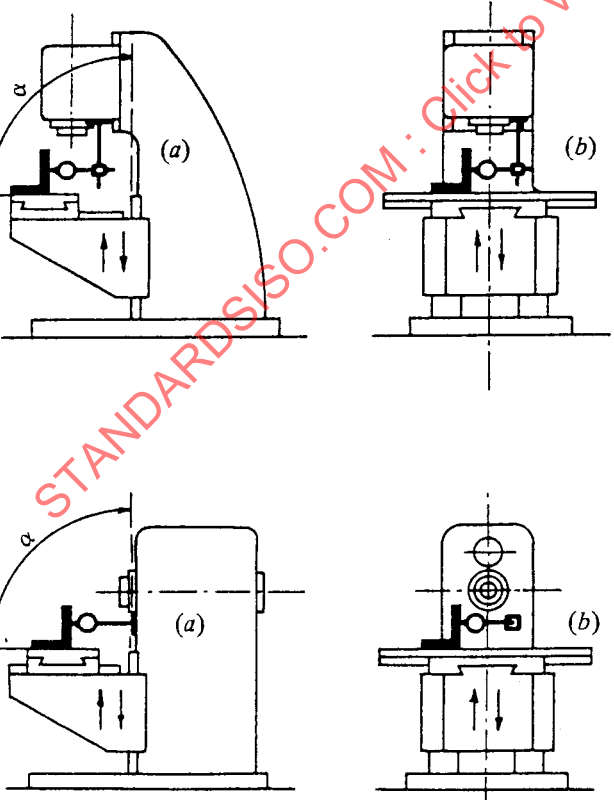
| Dimensions                                                                      | Nature of test                                                                                                                                                                                                                                                                                                                                                                                                    | Cutting conditions                                                      | Checks to be applied                                                                                                                                                                                                                                                                   | Permissible deviation                   | Measuring instrument                                                                    |
|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------|
|  | <p><b>A Vertical milling machines</b></p> <p>Milling of surface A by automatic longitudinal movement of the table and manual transverse movement of the cross slide, in two cuts overlapping by about 5 to 10 mm.</p> <p>Milling of strips of surfaces B, C and D by automatic longitudinal movement of the table, automatic transverse movement of the cross slide and manual vertical movement of the knee.</p> | <p>With a shell end mill.</p> <p>Slab milling with the same cutter.</p> | <p>(a) Surface A on each block should be flat.</p> <p>(b) The height <math>H</math> of the block (or blocks) should be constant.</p> <p>The planes containing the strips of surfaces B, C and D should be perpendicular to each other and each one perpendicular to the surface A.</p> | <p>0.02</p> <p>0.03</p> <p>0.02/100</p> | <p>Straight edge and slip gauge or micrometer calliper</p> <p>Square and slip gauge</p> |
|                                                                                 | <p><b>B Horizontal milling machines</b></p> <p>Milling of surface B by automatic longitudinal movement of the table and manual vertical movement of the knee, in two cuts overlapping by about 5 to 10 mm.</p> <p>Milling of strips of surfaces A, C and D by automatic longitudinal movement of the table, automatic vertical movement of the knee and manual transverse movement of the cross slide.</p>        | <p>With a shell end mill.</p> <p>Slab milling with the same cutter.</p> | <p>Surface B on each block should be flat.</p> <p>(a) The planes containing the strips of surfaces C, A and D should be perpendicular to each other and each one perpendicular to the surface B.</p> <p>(b) The height <math>H</math> of the block (or blocks) should be constant.</p> | <p>0.02</p> <p>0.02/100</p> <p>0.03</p> | <p>Straight edge and slip gauge or micrometer calliper</p> <p>Square and slip gauge</p> |

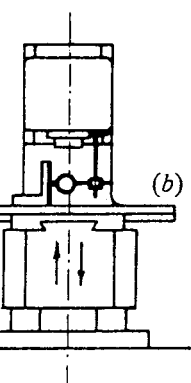
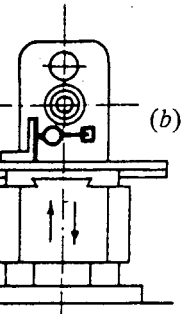
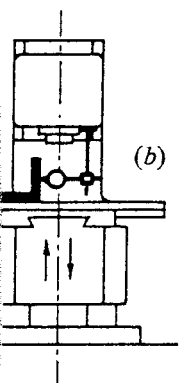
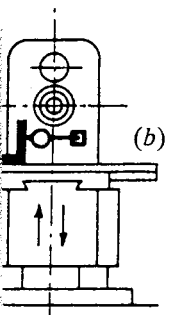
Dimensions in millimetres

|                                                                                                                    | Cutting conditions                                                                  | Checks to be applied                                                                                                                                                                                                                                                                   | Permissible deviation                   | Measuring instruments                                                                     | Observations and references to the test code ISO/R 230                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>oma-<br/>of the<br/>verse<br/>de, in<br/>about</p> <p>s B, C<br/>dinal<br/>oma-<br/>of the<br/>vertical</p>     | <p>With a shell<br/>end mill.</p> <p>Slab milling<br/>with the same<br/>cutter.</p> | <p>(a) Surface A on each block should be flat.</p> <p>(b) The height <math>H</math> of the block (or blocks) should be constant.</p> <p>The planes containing the strips of surfaces B, C and D should be perpendicular to each other and each one perpendicular to the surface A.</p> | <p>0.02</p> <p>0.03</p> <p>0.02/100</p> | <p>Straightedge and slip gauges or micrometer callipers</p> <p>Square and slip gauges</p> | <p>Clauses 3.1 and 3.22.</p> <p>Clauses 4.1 and 4.2.</p> <p>Before beginning the test make sure that surface E is flat.</p> <p>Test pieces should be placed in the longitudinal axis of the table so that the length <math>L</math> is equally distributed on either side of the table centre.</p> <p>NOTE. — Subject to agreement between the user and the manufacturer, the form of test piece shown in the diagram may be replaced by a simpler form of test piece having sides of full width, in which case tests carried out using this form will be at least as severe as those carried out using the form in the diagram.</p> |
| <p>oma-<br/>of the<br/>move-<br/>cuts<br/>5 to</p> <p>A, C<br/>dinal<br/>auto-<br/>of the<br/>verse<br/>slide.</p> | <p>With a shell<br/>end mill.</p> <p>Slab milling<br/>with the same<br/>cutter.</p> | <p>Surface B on each block should be flat.</p> <p>(a) The planes containing the strips of surfaces C, A and D should be perpendicular to each other and each one perpendicular to the surface B.</p> <p>(b) The height <math>H</math> of the block (or blocks) should be constant.</p> | <p>0.02</p> <p>0.02/100</p> <p>0.03</p> | <p>Straightedge and slip gauges or micrometer callipers</p> <p>Square and slip gauge</p>  | <p>The cutter should be sharpened on its arbor and when mounted should conform to the following tolerances:</p> <p>1. Out of round<br/><math>\leq 0.02</math></p> <p>2. Run-out<br/><math>\leq 0.02</math></p> <p>3. Camming<br/><math>\leq 0.03</math></p> <p>All non-operating slides should be locked during cutting.</p>                                                                                                                                                                                                                                                                                                         |

#### 4. TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

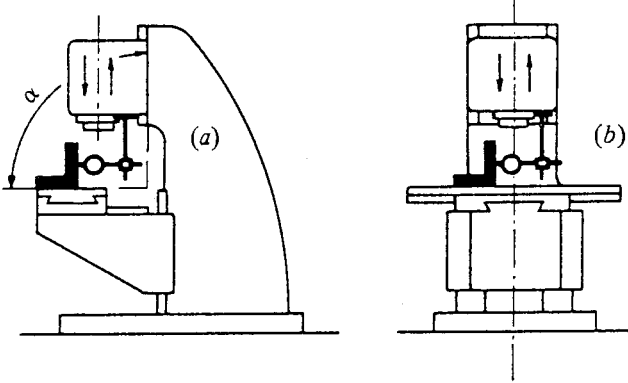
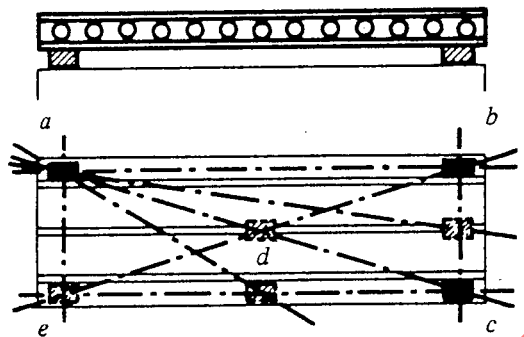
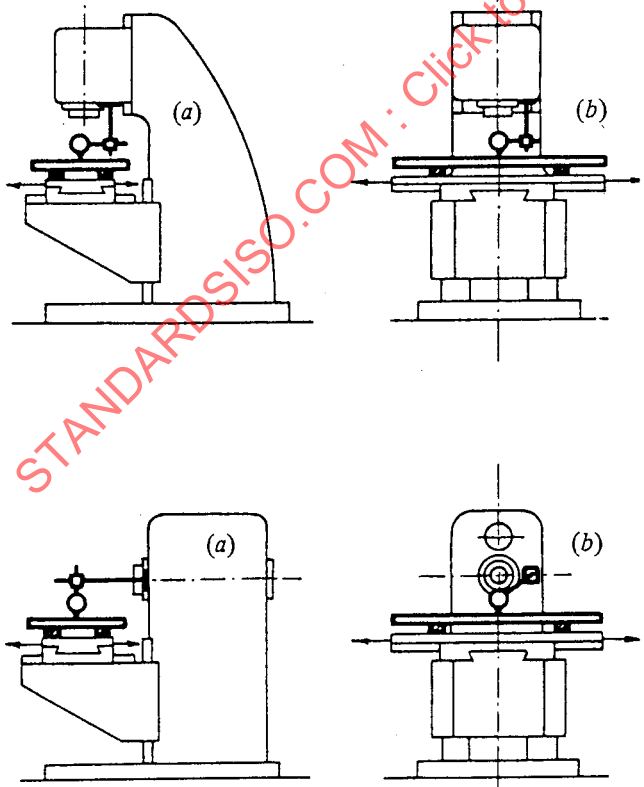
##### 4.1 Geometrical tests

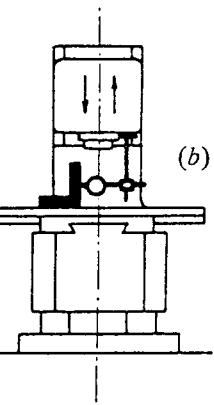
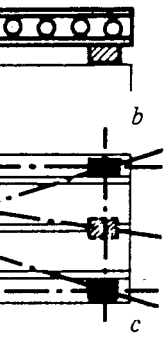
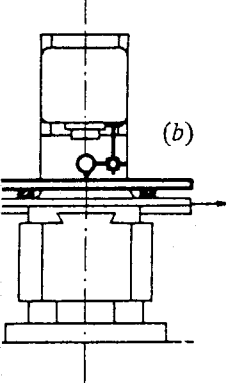
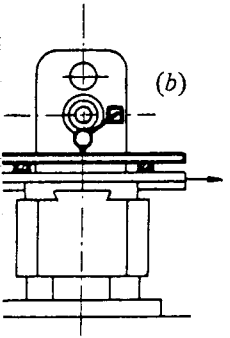
| No. | Diagram                                                                             | Object                                                                                                                                                                                                                                                                                                                                                                      |
|-----|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 1 |   | <p>Checking of straightness of the vertical movement of the knee :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p>                                                                                       |
|     |  | <p>Checking of squareness of the table surface to the column ways for knee (in three positions : in the middle and near the extremities of the travel) :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> |

|                                                                                                                                                                        | Object                                                                                                                                                                                                                                                                                                                                                                      | Permissible deviation                                                                               | Measuring instruments |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------|
| <br>    | <p>Checking of straightness of the vertical movement of the knee :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p>                                                                                       | <p>(a) 0.001<br/>for a measuring length of 12</p> <p>(b) 0.001<br/>for a measuring length of 12</p> | Dial gauge and square |
| <br> | <p>Checking of squareness of the table surface to the column ways for knee (in three positions : in the middle and near the extremities of the travel) :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> | <p>(a) 0.001 / 12<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.001 / 12</p>              | Dial gauge and square |

Dimensions in inches.

|                                                                                                                    | Permissible deviation                                                                                       | Measuring instruments | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| vertical move-<br>metry of the<br>al plane;<br>to the vertical<br>e machine or                                     | <p>(a) 0.001<br/>for a measuring length<br/>of 12</p> <p>(b) 0.001<br/>for a measuring length<br/>of 12</p> | Dial gauge and square | <p>Clause 5.232.1</p> <p>Instead of a straightedge, use the vertical arm of a square.</p> <p>Table in central position, table and cross slide locked, knee not locked.</p> <p>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 a fixed part of the machine.</p> |
| ble surface to<br>ee positions :<br>emities of the<br>metry of the<br>al plane;<br>to the vertical<br>e machine or | <p>(a) 0.001 / 12<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.001 / 12</p>                      | Dial gauge and square | <p>Clause 5.522.2</p> <p>Table in central position, table and cross slide locked.</p> <p>Knee locked when taking measurements.</p> <p>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 a fixed part of the machine.</p>                                         |

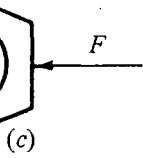
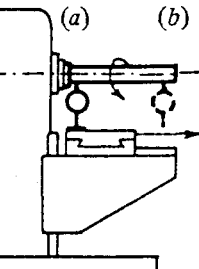
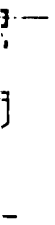
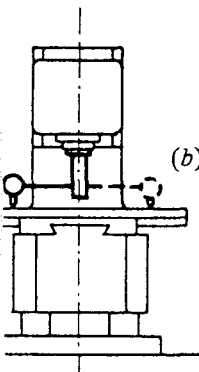
| No. | Diagram                                                                             | Object                                                                                                                                                                                                                                                                                                                 |
|-----|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 3 |    | <p>Checking of squareness of the table surface to the vertical movement of the spindle head slide :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> |
| G 4 |   | <p>Checking of flatness of the table surface.</p>                                                                                                                                                                                                                                                                      |
| G 5 |  | <p>Checking of parallelism of the table surface to its movement :</p> <p>(a) transversely;</p> <p>(b) longitudinally.</p>                                                                                                                                                                                              |

|                                                                                                                                                                                              | Object                                                                                                                                                                                                                                                                                                                 | Permissible deviation                                                                                                                                                         | Measuring instruments                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
|  <p>(b)</p>                                                                                                   | <p>Checking of squareness of the table surface to the vertical movement of the spindle head slide :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> | <p>(a) 0.001 / 12<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.001 / 12</p>                                                                                        | Dial gauge and square                            |
|  <p>b</p> <p>c</p>                                                                                           | <p>Checking of flatness of the table surface.</p>                                                                                                                                                                                                                                                                      | <p>0.0016 up to 40</p> <p>For each 40 increase in table length, add 0.0002</p> <p>Maximum permissible deviation : 0.002</p> <p>Local tolerance : 0.0008 for any 12 length</p> | Precision level or straight edge and slip gauges |
|  <p>(b)</p><br> <p>(b)</p> | <p>Checking of parallelism of the table surface to its movement:</p> <p>(a) transversely;</p> <p>(b) longitudinally.</p>                                                                                                                                                                                               | <p>(a) 0.001<br/>for any 12 length</p> <p>(b) 0.001<br/>for any 12 length</p> <p>Maximum permissible deviation : 0.002</p>                                                    | Straightedge and dial gaug                       |

Dimensions in inches

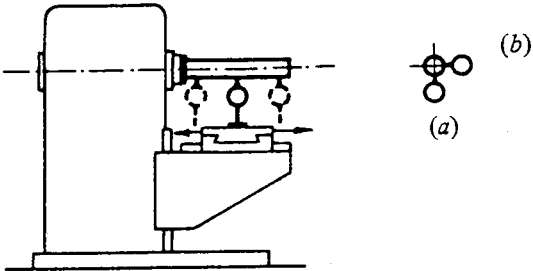
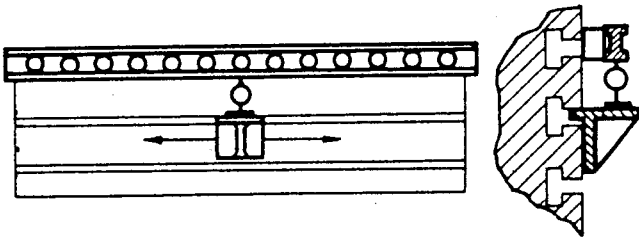
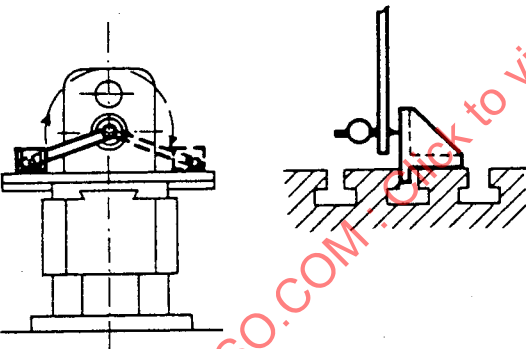
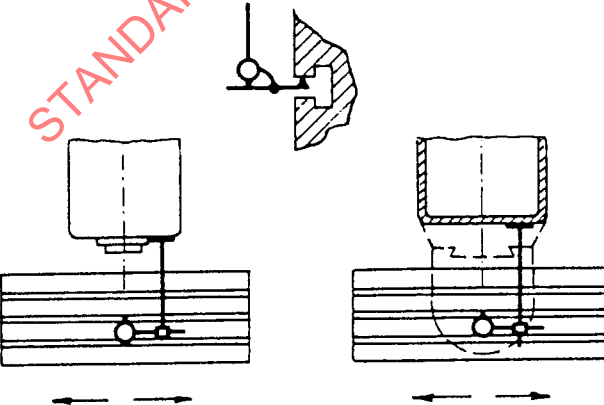
|                                                                                                                              | Permissible deviation                                                                                                                                                                              | Measuring instruments                            | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>table surface to<br/>slide head slide :</p> <p>mmetry of the<br/>cal plane;</p> <p>to the vertical<br/>the machine or</p> | <p>(a) 0.001 /12<br/>with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.001 /12</p>                                                                                                               | Dial gauge and square                            | <p>Clause 5.522.2</p> <p>Table in central position, knee and table locked.</p> <p>Spindle head slide locked when taking measurements.</p> <p>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 slide of the machine.</p>                                                                                                                                                                                                                                                                                                                     |
| table surface.                                                                                                               | <p>0.0016 up to 40</p> <p>For each 40 increase in table length, add 0.0002</p> <p>Maximum permissible deviation :</p> <p>0.002</p> <p>Local tolerance :</p> <p>0.0008</p> <p>for any 12 length</p> | Precision level or straight-edge and slip gauges | <p>Clauses 5.322 and 5.323</p> <p>Table and cross slide in central position, table not locked, knee and cross slide locked.</p> <p>NOTE. — The alphabetical references on the diagram correspond to those used in Figure 19 of ISO Recommendation R 230.</p>                                                                                                                                                                                                                                                                                                                                                                                      |
| table surface to                                                                                                             | <p>(a) 0.001<br/>for any 12 length</p> <p>(b) 0.001<br/>for any 12 length</p> <p>Maximum permissible deviation :</p> <p>0.002</p>                                                                  | Straightedge and dial gauge                      | <p>Clause 5.422.21</p> <p>The stylus of the dial gauge to be placed approximately at the working position of the tool.</p> <p>The measurement may be made on a straight-edge laid parallel to the table surface.</p> <p>If the table length is greater than 64 in, carry out the inspection by successive movements of the straightedge.</p> <p>Knee locked.</p> <p>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 a fixed part of the machine.</p> <p>(a) Table and spindle head slide locked;</p> <p>(b) Cross slide and spindle head slide locked.</p> |

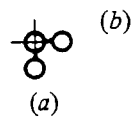
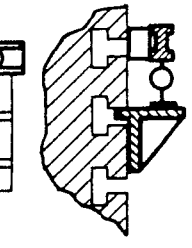
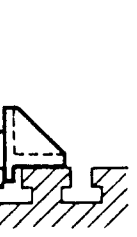
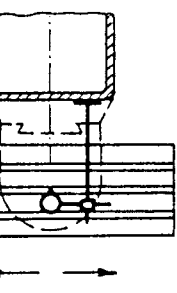
| No. | Diagram | Object                                                                                                                                                                                                                                                                                  |
|-----|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 6 |         | <p>(a) Measurement of run-out of the external centring surface on the spindle nose (for machines having this feature).</p> <p>(b) Measurement of camming of the face of the spindle nose (including periodic axial slip).</p> <p>(c) Measurement of periodic axial slip.</p>            |
| G 7 |         | <p>Measurement of run-out of the internal taper of the spindle :</p> <p>(a) at the mouth of taper;</p> <p>(b) at a distance of 12 from the spindle nose.</p>                                                                                                                            |
| G 8 |         | <p>Checking of parallelism of the spindle axis to the table surface.</p>                                                                                                                                                                                                                |
| G 9 |         | <p>Checking of squareness of the spindle axis to the table surface :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> |

|                                                                                                 | Object                                                                                                                                                                                                                                                                                  | Permissible deviation                                                                              | Measuring instruments       |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------------------|
|  <p>(c)</p>      | <p>(a) Measurement of run-out of the external centring surface on the spindle nose (for machines having this feature).</p> <p>(b) Measurement of camming of the face of the spindle nose (including periodic axial slip).</p> <p>(c) Measurement of periodic axial slip.</p>            | <p>(a) 0.0004</p> <p>(b) 0.0008</p> <p>(c) 0.0004</p>                                              | Dial gauge                  |
|  <p>(a) (b)</p> | <p>Measurement of run-out of the internal taper of the spindle :</p> <p>(a) at the mouth of taper;</p> <p>(b) at a distance of 12 from the spindle nose.</p>                                                                                                                            | <p>(a) 0.0004</p> <p>(b) 0.0008</p>                                                                | Dial gauge and test mandrel |
|                 | <p>Checking of parallelism of the spindle axis to the table surface.</p>                                                                                                                                                                                                                | <p>0.001</p> <p>for a measuring length of 12 (free end of the test mandrel inclined downwards)</p> | Dial gauge and test mandrel |
|  <p>(b)</p>    | <p>Checking of squareness of the spindle axis to the table surface :</p> <p>(a) in the vertical plane of symmetry of the machine or transverse vertical plane;</p> <p>(b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.</p> | <p>(a) 0.001 / 12 with <math>\alpha \leq 90^\circ</math></p> <p>(b) 0.001 / 12</p>                 | Dial gauge                  |

Dimensions in inches

|                                                                                                | Permissible deviation                                                                         | Measuring instruments       | Observations<br>and references to the test code ISO/R 230                                                                                                                        |
|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| of the external<br>mandrel nose (for<br>test).                                                 | (a) 0.0004                                                                                    | Dial gauge                  | (a) Clause 5.612.2                                                                                                                                                               |
| of the face of<br>periodic axial                                                               | (b) 0.0008                                                                                    |                             | (b) Clause 5.632<br>The distance $A$ of dial gauge (b) from the<br>spindle axis should be as large as possible.                                                                  |
| axial slip.                                                                                    | (c) 0.0004                                                                                    |                             | (c) Clauses 5.662.1 and 5.622.2<br>A force $F$ , specified by the manufacturer<br>of the machine, should be exerted by<br>pressing towards the housing for tests (b)<br>and (c). |
| internal taper                                                                                 |                                                                                               | Dial gauge and test mandrel | Clause 5.612.3                                                                                                                                                                   |
| on the spindle                                                                                 | (a) 0.0004<br>(b) 0.0008                                                                      |                             |                                                                                                                                                                                  |
| spindle axis                                                                                   | 0.001<br>for a measuring length of 12<br>(free end of the test mandrel<br>inclined downwards) | Dial gauge and test mandrel | Clause 5.412.4.<br>Table and cross slide not locked, knee locked.                                                                                                                |
| spindle axis to the<br>symmetry of the<br>axial plane;<br>to the vertical<br>of the machine or | (a) 0.001 / 12<br>with $\alpha \leq 90^\circ$<br>(b) 0.001 / 12                               | Dial gauge                  | Clauses 5.512.1 and 5.512.42<br>Spindle head slide, table, cross slide and knee<br>locked.                                                                                       |

| No.  | Diagram                                                                             | Object                                                                                                                                                             |
|------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G 10 |    | <p>Checking of parallelism of the spindle axis to the transverse movement of the table :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p> |
| G 11 |    | <p>Checking of straightness of the median or reference tee slot of the table.</p>                                                                                  |
| G 12 |  | <p>Checking of squareness of the spindle axis to the median or reference tee slot of the table.</p>                                                                |
| G 13 |  | <p>Checking of parallelism of the median or reference tee slot to the longitudinal movement of the table.</p>                                                      |

|                                                                                    | Object                                                                                                                                                             | Permissible deviation                                                                                                                                     | Measuring instruments                                                   |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
|    | <p>Checking of parallelism of the spindle axis to the transverse movement of the table :</p> <p>(a) in the vertical plane;</p> <p>(b) in the horizontal plane.</p> | <p>(a) 0.001<br/>for a measuring length of 12<br/>(free end of the test mandrel inclined downwards)</p> <p>(b) 0.001<br/>for a measuring length of 12</p> | Dial gauge and test mandrel                                             |
|    | <p>Checking of straightness of the median or reference tee slot of the table.</p>                                                                                  | <p>0.0004<br/>for any 20 length<br/>Maximum permissible deviation :<br/>0.0012</p>                                                                        | Straightedge and dial gauge or slip gauges, or taut wire and microscope |
|  | <p>Checking of squareness of the spindle axis to the median or reference tee slot of the table.</p>                                                                | 0.0008 / 12*                                                                                                                                              | Dial gauge                                                              |
|  | <p>Checking of parallelism of the median or reference tee slot to the longitudinal movement of the table.</p>                                                      | <p>0.0006<br/>for any 12 length<br/>Maximum permissible deviation :<br/>0.0016</p>                                                                        | Dial gauge                                                              |

Dimensions in inches

|                                      | Permissible deviation                                                                                                                                                       | Measuring instruments                                                         | Observations<br>and references to the test code ISO/R 230                                                                                                                                                                                                      |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Spindle axis to the<br>table         | <p>(a) 0.001<br/>for a measuring length<br/>of 12<br/>(free end of the test<br/>mandrel inclined down-<br/>wards)</p> <p>(b) 0.001<br/>for a measuring length<br/>of 12</p> | Dial gauge and test mandrel                                                   | <p>Clause 5.422.3.</p> <p>Table in central position.</p> <p>Knee locked.</p>                                                                                                                                                                                   |
| Median or<br>reference               | <p>0.0004<br/>for any 20 length</p> <p>Maximum permissible devi-<br/>ation :<br/>0.0012</p>                                                                                 | Straightedge and dial gauge<br>or slip gauges, or taut wire<br>and microscope | <p>Clauses 5.212, 5.212.1, 5.212.3 or 5.232</p> <p>The straightedge may be placed directly on the<br/>table.</p>                                                                                                                                               |
| Spindle axis to the<br>of the table. | 0.0008 /12*                                                                                                                                                                 | Dial gauge                                                                    | <p>Clauses 5.512.1 and 5.512.52</p> <p>Table in central position.</p> <p>Table, cross slide and knee locked.</p> <p>* Distance between the two points touched.</p>                                                                                             |
| Median or refer-<br>movement of      | <p>0.0006<br/>for any 12 length</p> <p>Maximum permissible devi-<br/>ation :<br/>0.0016</p>                                                                                 | Dial gauge                                                                    | <p>Clauses 5.422.1 and 5.422.21</p> <p>Cross slide and knee locked.</p> <p>If the spindle can be locked, the dial gauge may<br/>be mounted on it. If the spindle cannot be<br/>locked, the dial gauge should be placed on a<br/>fixed part of the machine.</p> |