
International Standard



1984

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Acceptance conditions for milling machines with table of fixed height with horizontal or vertical spindle — Testing of accuracy

Conditions de réception des machines à fraiser à table de hauteur fixe, à broche horizontale ou verticale — Contrôle de la précision

Second edition — 1982-02-01

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Descriptors : machine tools, milling machines, tests, testing conditions, accuracy.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1984 was developed by Technical Committee ISO/TC 39, *Machine tools*.

This second edition was submitted directly to the ISO Council, in accordance with clause 5.10.1 of part 1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 1984-1974), which had been approved by the member bodies of the following countries :

Belgium	India	South Africa, Rep. of
Chile	Italy	Spain
Czechoslovakia	Japan	Switzerland
Egypt, Arab Rep. of	Korea, Rep. of	Thailand
France	Netherlands	United Kingdom
Germany, F.R.	New Zealand	USA
Greece	Philippines	
Hungary	Portugal	

The member body of the following country had expressed disapproval of the document on technical grounds :

Sweden

Acceptance conditions for milling machines with table of fixed height with horizontal or vertical spindle — Testing of accuracy

1 Scope and field of application

This International Standard specifies, with reference to ISO/R 230, both geometrical and practical tests on general purpose and normal accuracy milling machines with table of fixed height, with horizontal or vertical spindle, and the corresponding permissible deviations which apply.

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

2 Reference

ISO/R 230, *Machine tool test code*.

3 Preliminary remarks

3.1 In this International Standard, all the dimensions are expressed in millimetres and in inches.

3.2 To apply this International Standard, reference should be made to ISO/R 230, especially for the installation of the machine before testing, warming up of spindles and other mov-

ing parts, description of measuring methods and recommended accuracy of testing equipment.

3.3 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and 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.

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

3.5 Practical tests should be made with finishing cuts — for example : depth = 0,1 mm (0,004 in), feed per tooth = 0,1 mm (0,004 in) — and not with roughing cuts which are liable to generate appreciable cutting forces.

3.6 When the tolerance is established for a measuring range different from that given in this International Standard (see clause 2.311 in ISO/R 230), it should be taken into consideration that the minimum value of tolerance is 0,01 mm (0,000 4 in).

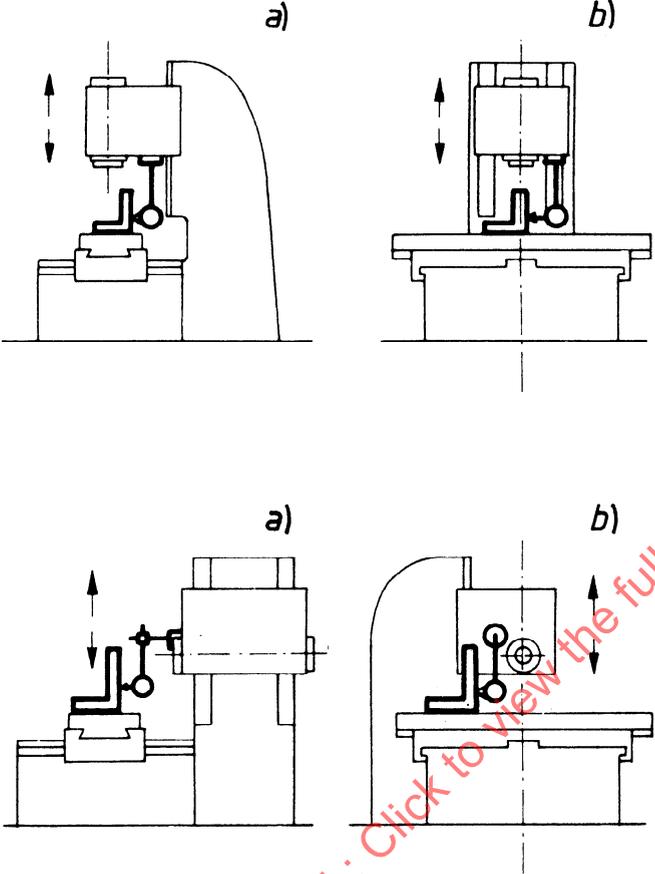
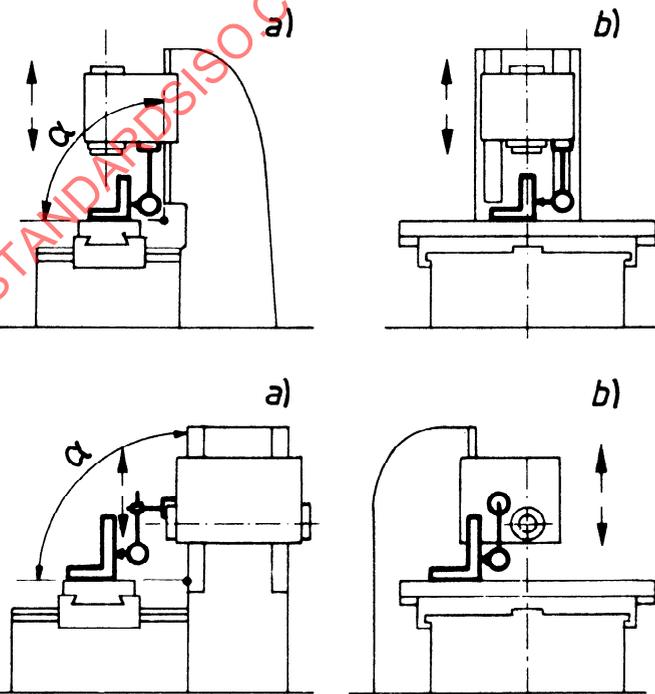
3.7 For reasons of simplicity, the diagrams in this International Standard illustrate only one type of machine.

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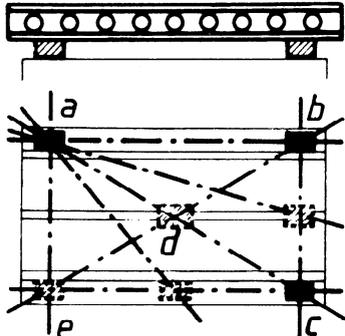
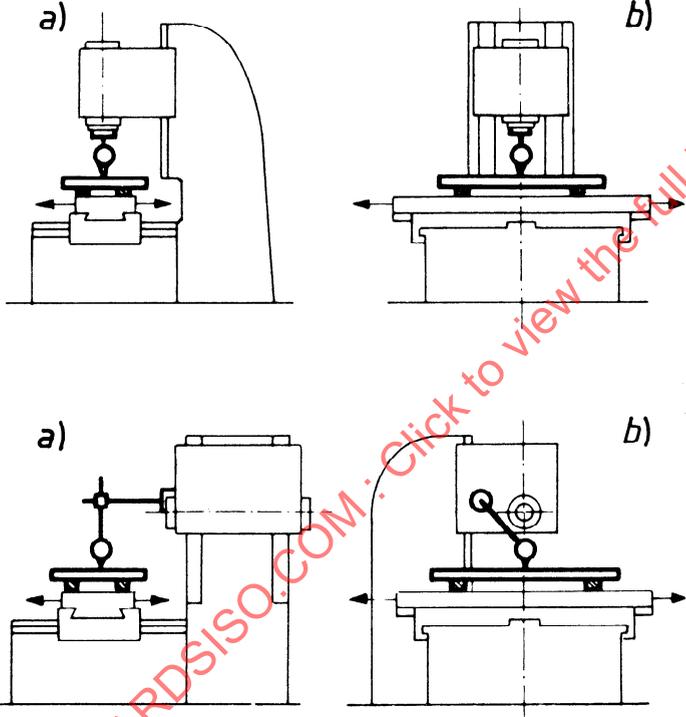
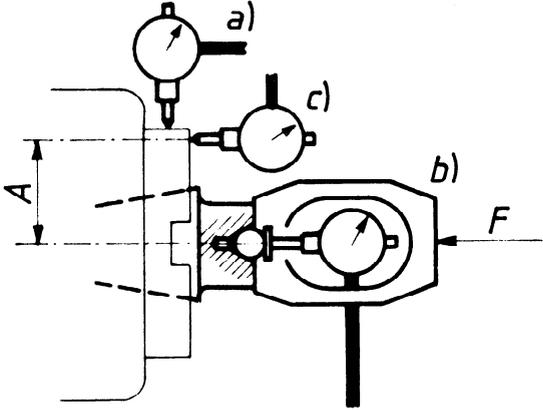
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4 Test conditions and permissible deviations

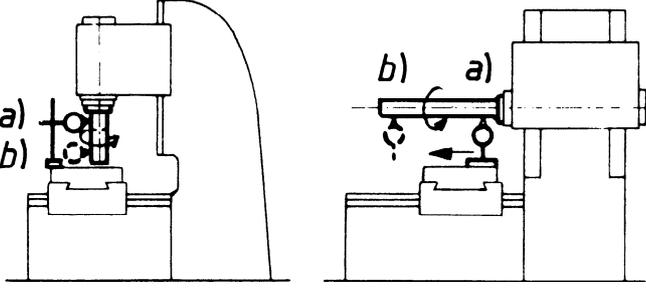
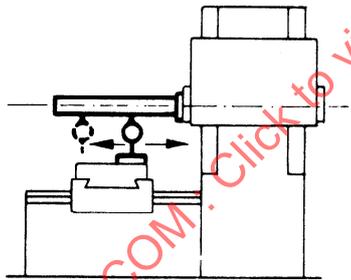
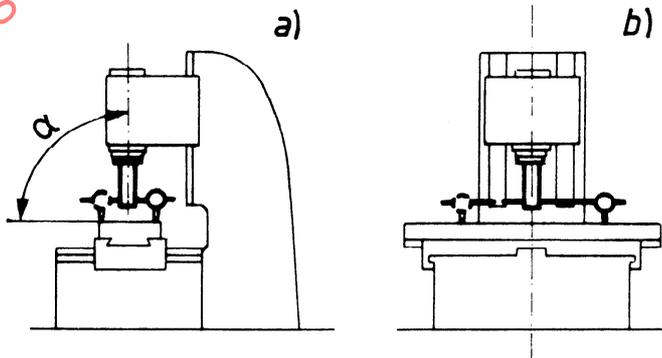
4.1 Geometrical tests

No.	Diagram	Object
G 1	 <p>The diagrams for G 1 show two views of a machine's spindle head slide. Diagram a) is a side view showing the vertical movement of the slide, indicated by a double-headed arrow. Diagram b) is a front view showing the movement in a plane perpendicular to the vertical plane of symmetry, also indicated by a double-headed arrow.</p>	<p>Verification of straightness of the vertical movement of the spindle head slide :</p> <p>a) in the vertical plane of symmetry of the machine;</p> <p>b) in the plane perpendicular to the vertical plane of symmetry of the machine.</p>
G 2	 <p>The diagrams for G 2 show two views of a machine's table surface. Diagram a) is a side view showing the squareness of the table surface to the vertical movement of the spindle head slide, with a curved arrow indicating the angle of measurement. Diagram b) is a front view showing the squareness in a plane perpendicular to the vertical plane of symmetry, with a double-headed arrow indicating the movement.</p>	<p>Verification 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;</p> <p>b) in the plane perpendicular to the vertical plane of symmetry of the machine.</p>

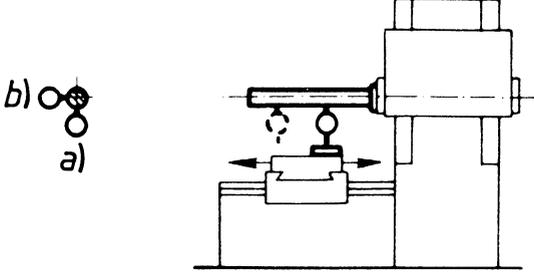
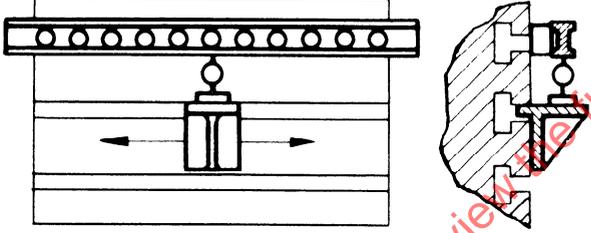
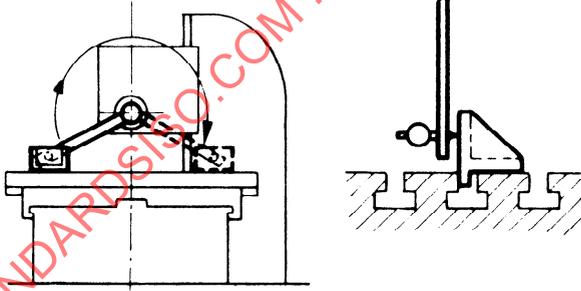
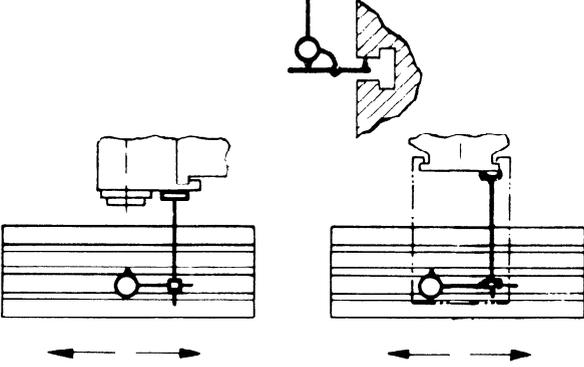
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,025 a measuring length 10	a) 0.001 for a measuring length of 12	Dial gauge and square	Clause 5.232.1. Instead of the straightedge specified in the test code ISO/R 230, use the vertical arm of a square. Table in central position, table and cross slide locked. If the spindle can be locked, the dial gauge may be mounted on it. If the spindle cannot be locked, the dial gauge shall be placed on the spindle head of the machine.
0,025 a measuring length 30	b) 0.001 for a measuring length of 12		
0,025/300 with $\alpha \leq 90^\circ$	a) 0.001/12 with $\alpha \leq 90^\circ$	Dial gauge and square	Clause 5.522.2. Table in central position, cross slide and table locked. Spindle head slide locked when taking measurements. If the spindle can be locked, the dial gauge may be mounted on it. If the spindle cannot be locked, the dial gauge shall be placed on the spindle head of the machine.
0,025/300	b) 0,001/12		

No.	Diagram	Object	
G 3		<p>Verification of flatness of the table surface.</p>	<p>For in le Maxi ation</p> <p>Local</p> <p>for of 30</p>
G 4		<p>a) Verification of parallelism of the table surface to the transverse movement of the table (or spindle).</p> <p>b) Verification of parallelism of the table surface to the longitudinal movement of the table.</p>	<p>a)</p> <p>for of 30</p> <p>b)</p> <p>for of 30</p> <p>Maxi ation</p>
G 5		<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 periodic axial slip.</p> <p>c) Measurement of camming of the face of the spindle nose (including periodic axial slip).</p>	<p>a)</p> <p>b)</p> <p>c)</p>

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,04 up to 1000 For each 1 000 mm increase in length, add 0,005 Maximum permissible deviation : 0,05 Local tolerance : 0,02 for any measuring length of 12	0.0016 up to 40 For each 40 in increase in length, add 0.0002 Maximum permissible deviation : 0.002 Local tolerance : 0.0008 for any measuring length of 12	Precision level or straightedge and slip gauges	Clauses 5.322 and 5.323. Table and cross slide in central position, table not locked, cross slide locked.
0,025 for any measuring length of 12 0,025 for any measuring length of 12 Maximum permissible deviation : 0,05	a) 0.001 for any measuring length of 12 b) 0.001 for any measuring length of 12 Maximum permissible deviation : 0.002	Straightedge and dial gauge	Clause 5.422.21 The stylus of the dial gauge to be placed approximately at the working position of the tool. The measurement may be made on a straightedge laid parallel to the table surface. If the table length is greater than 1 600 mm (64 in), the inspection shall be carried out by successive movements of the straightedge. If the spindle can be locked, then after locking the spindle head slide, the dial gauge may be mounted on it. If the spindle cannot be locked, then the dial gauge shall be placed on a fixed part of the machine. a) table and spindle head slide locked; b) cross slide and spindle head slide locked.
0,01 0,01 0,02	a) 0.0004 b) 0.0004 c) 0.0008	Dial gauge	a) Clause 5.612.2. b) Clauses 5.622.1 and 5.622.2. A force F , specified by the manufacturer of the machine, shall be exerted by pressing towards the housing for tests b) and c). c) Clause 5.632. The distance A of dial gauge c) from the spindle axis shall be as large as possible.

No.	Diagram	Object	
G 6		<p>Measurement of run-out of the internal taper of the spindle :</p> <p>a) near the mouth of taper;</p> <p>b) at a distance of 300 mm (12 in) from the spindle nose.</p>	<p>a)</p> <p>b)</p>
G 7		<p>Verification of parallelism of the spindle axis to the table surface (for horizontal spindle machines only).</p>	<p>for of 3C (free inclir</p>
G 8		<p>Verification of squareness of the spindle axis to the table surface (for vertical spindle machines only) :</p> <p>a) in the vertical plane of symmetry of the machine;</p> <p>b) in the plane perpendicular to the vertical plane of symmetry of the machine.</p>	<p>a)</p> <p>b)</p>

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,01	a) 0.0004	Dial gauge and test mandrel	Clause 5.612.3.
0,02	b) 0.0008		
0,025 measuring length of the test mandrel inclined downwards)	0.001 for a measuring length of 12 (free end of the test mandrel inclined downwards)	Dial gauge and test mandrel	Clause 5.412.4. Table and cross slide unlocked, spindle head slide locked.
0,025/300 with $\alpha \leq 90^\circ$	a) 0.001/12 with $\alpha \leq 90^\circ$	Dial gauge	Clauses 5.512.1 and 5.512.42. Table, cross slide and spindle head slide locked.
0,025/300	b) 0.001/12		

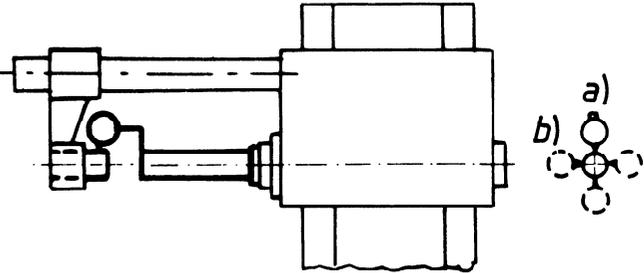
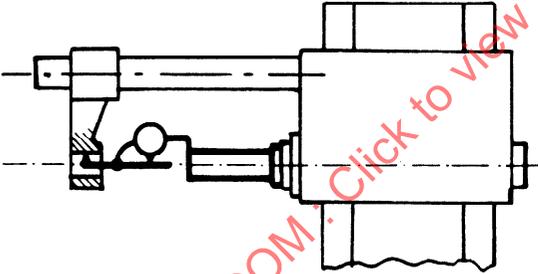
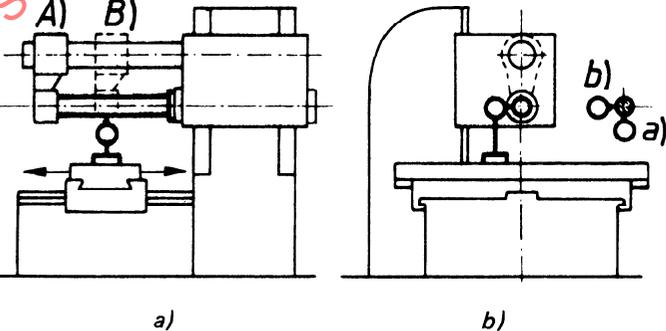
No.	Diagram	Object	
G 9		<p>Verification of parallelism of the spindle axis to the transverse movement of the table (only for machines with transverse table movement) :</p> <p>a) in the vertical plane;</p> <p>b) in the horizontal plane.</p>	<p>a) for of 30 (free incl: b) for of 30</p>
G 10		<p>Verification of straightness of the median or reference tee slot of the table.</p>	<p>for of 50 Max ation</p>
G 11		<p>Verification of squareness of the spindle axis to the median or reference tee slot of the table (for horizontal spindle machines only).</p>	
G 12		<p>Verification of parallelism of the median or reference tee slot to the longitudinal movement of the table.</p>	<p>for of 30 Max ation</p>

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,025 measuring length of the test mandrel inclined downwards)	a) 0.001 for a measuring length of 12 (free end of the test mandrel inclined downwards)	Dial gauge and test mandrel	Clause 5.422.3. Table in central position, spindle head slide locked.
0,025 measuring length	b) 0.001 for a measuring length of 12		
0,01 measuring length Maximum permissible devi-	0.0004 for any measuring length of 20 Maximum permissible devi- ation :	Straightedge and dial gauge or slip gauges, or taut wire and micro- scope	Clauses 5.212, 5.212.1, 5.212.3 or 5.232. The straightedge may be placed directly on the table.
0,03	0.001 2		
0,02/300*	0.0008/12*	Dial gauge	Clauses 5.512.1 and 5.512.52. Table in central position. Table, cross slide and spindle head slide locked. * Distance between the two points touched.
0,015 measuring length Maximum permissible devi-	0.0006 for any measuring length of 12 Maximum permissible devi- ation :	Dial gauge	Clauses 5.422.1 and 5.422.21. Cross slide and spindle head slide locked. If the spindle can be locked, the dial gauge may be mounted on it. If the spin- dle cannot be locked, then the dial gauge shall be placed on a fixed part of the machine.
0,04	0.0016		

No.	Diagram	Object
G 13		<p>Verification of squareness of the transverse movement of the table (or spindle) to the longitudinal movement of the table.</p>
G 14		<p>Verification 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>Verification 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>

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,02/300	0.0008/12	Straightedge, dial gauge and square	<p>Clause 5.522.4.</p> <p>a) The straightedge shall be set parallel to the table longitudinal movement; then the square shall be placed against the straightedge. The table shall then be locked in central position.</p> <p>b) The table transverse movement shall then be checked.</p> <p>If the spindle can be locked, then after locking the spindle head slide, the dial gauge may be mounted on it. If the spindle cannot be locked, then the dial gauge shall be placed on a fixed part of the machine.</p>
<p>0,02</p> <p>a measuring length of 100</p> <p>or arm inclined downwards</p> <p>0,02</p> <p>a measuring length of 100</p>	<p>a) 0.0008</p> <p>for a measuring length of 12</p> <p>(over arm inclined downwards)</p> <p>b) 0.0008</p> <p>for a measuring length of 12</p>	Dial gauge and possibly precision level	<p>Clause 5.412.5</p> <p>or</p> <p>clauses 5.412.1 and 5.412.3.</p> <p>Clause 5.422.4.</p> <p>Over arm(s) locked.</p>
<p>0,02</p> <p>a measuring length of 100</p> <p>or arm inclined downwards</p> <p>0,02</p> <p>a measuring length of 100</p>	<p>a) 0.0008</p> <p>for a measuring length of 12</p> <p>(over arm inclined downwards)</p> <p>b) 0.0008</p> <p>for a measuring length of 12</p>		

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No.	Diagram	Object
G 15		
	<p data-bbox="525 916 695 943">First alternative</p> 	<p data-bbox="995 976 1449 1061">Verification of coincidence of the axis of the bore of the arbor support with the spindle axis :</p> <p data-bbox="995 1173 1251 1200">a) in the vertical plane;</p> <p data-bbox="995 1330 1283 1357">b) in the horizontal plane.</p>
	<p data-bbox="517 1487 716 1514">Second alternative</p> 	

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a)
b)

a)
b)

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,03	a) 0.0012	Dial gauge and test mandrel	<p>Clauses 5.442 and 5.422.4.</p> <p>Arbor support located 300 mm (12 in) away from the spindle nose.</p> <p>The measurement shall be made as near as possible to the arbor support.</p> <p>Over arm locked and arbor support not connected to the machine bed.</p>
of the bore of the support lower than spindle axis)	(axis of the bore of the arbor support lower than the spindle axis)		
0,03	b) 0.0012		<p>It is unnecessary to follow the test code ISO/R 230; 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 shall be divided by 2 for comparison with the permissible deviation.</p>
0,04	a) 0.0016	Dial gauge and test mandrel	<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 shall not be divided by 2.</p>
any measuring length of 10	for any measuring length of 12		
mandrel inclined downwards on the side of the bore of the arbor support).	(mandrel inclined downwards on the side of the bore of the arbor support).		
0,03	b) 0.0012		
any measuring length of 10	for any measuring length of 12		