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

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

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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.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 39 has reviewed ISO Recommendation R 1984 and found it suitable for transformation. International Standard ISO 1984 therefore replaces ISO Recommendation R 1984-1971.

ISO Recommendation R 1984 was 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	New Zealand	U.S.A.
Greece	Philippines	
Hungary	Portugal	

The Member Body of the following country expressed disapproval of the Recommendation on technical grounds :

Sweden

The Member Body of the following country disapproved the transformation of ISO/R 1984 into an International Standard :

United Kingdom

Printed in Switzerland

Test 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, *Machine tool test code*, both geometrical and practical tests on general purpose and normal accuracy milling machines with table of fixed height, with horizontal or vertical spindle, and the corresponding permissible deviations which apply.

It deals only with the verification of accuracy of the machine 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 PRELIMINARY REMARKS

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

2.2 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 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 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 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.

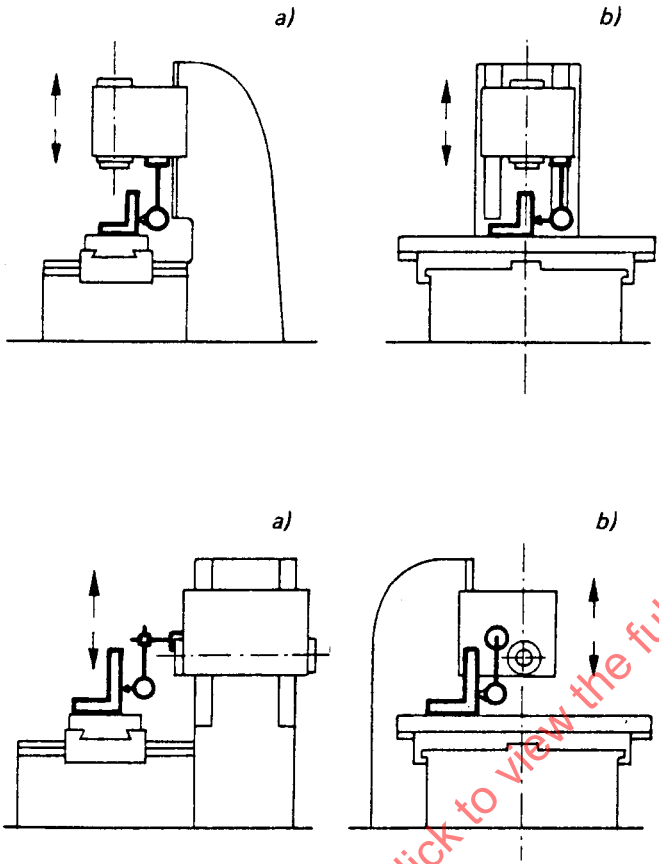
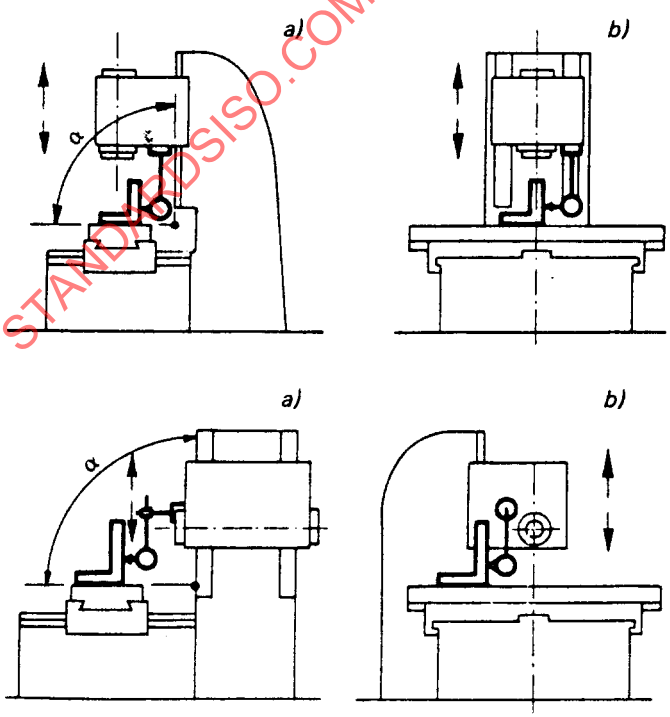
2.5 Practical tests should be made with finishing cuts – for example : depth = 0,1 mm (0.004 in), feed per tooth = 0,1 mm (0,004 in) – and not with roughing cuts which are liable to generate appreciable cutting forces.

2.6 When the tolerance is established for a measuring range different from that given in this International Standard (see 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).

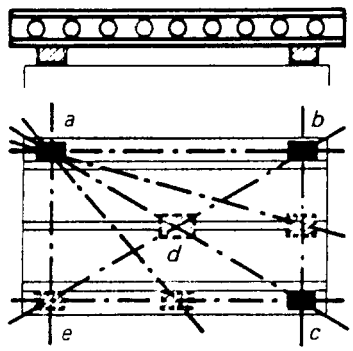
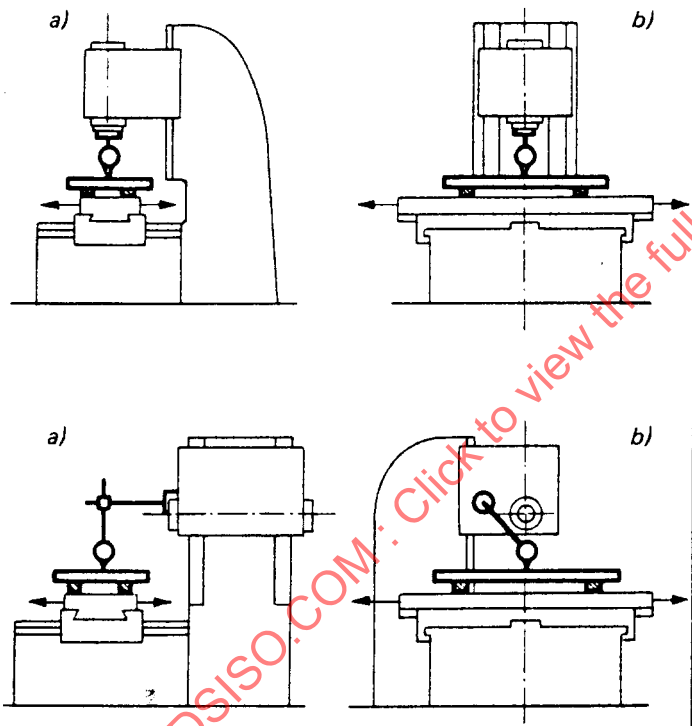
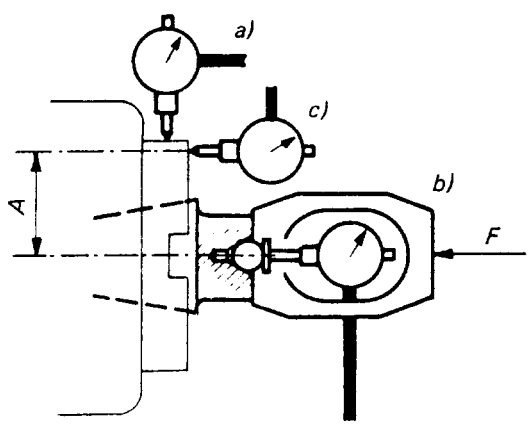
2.7 For reasons of simplicity, the diagrams in this International Standard illustrate only one type of machine.

3 TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

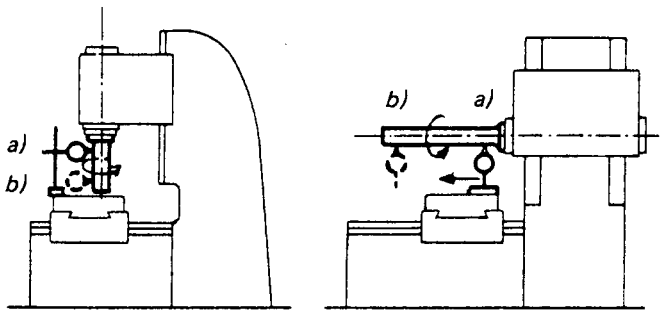
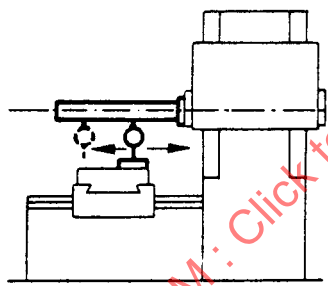
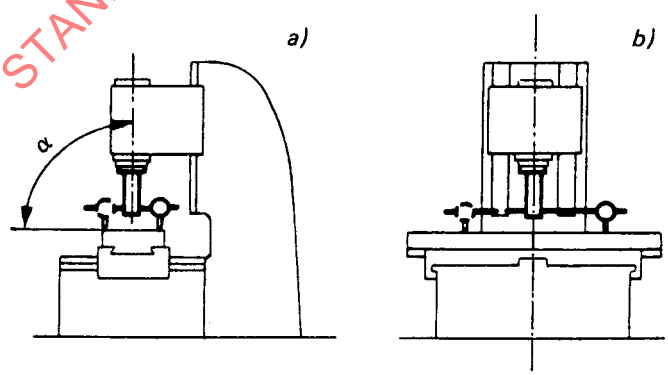
3.1 Geometrical tests

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

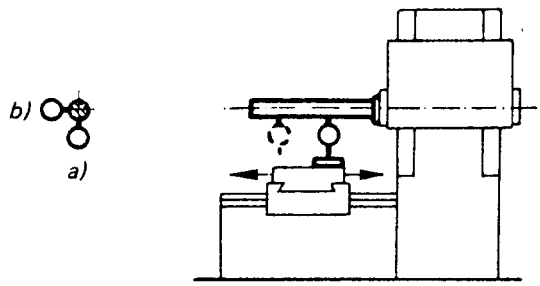
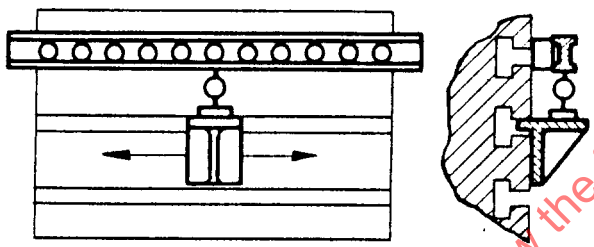
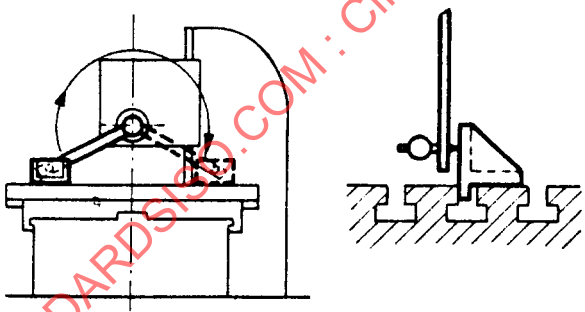
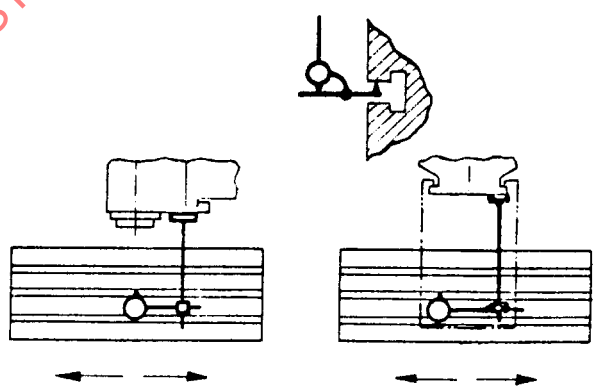
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
a) 0,025 for a measuring length of 300 *b)* 0,025 for a measuring length of 300	*a)* 0.001 for a measuring length of 12 *b)* 0.001 for a measuring length of 12	Dial gauge and square	Clause 5.232.1. 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.
a) 0,025/300 with $\alpha \leqslant 90^\circ$ *b)* 0,025/300	*a)* 0.001/12 with $\alpha \leqslant 90^\circ$ *b)* 0,001/12	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.

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

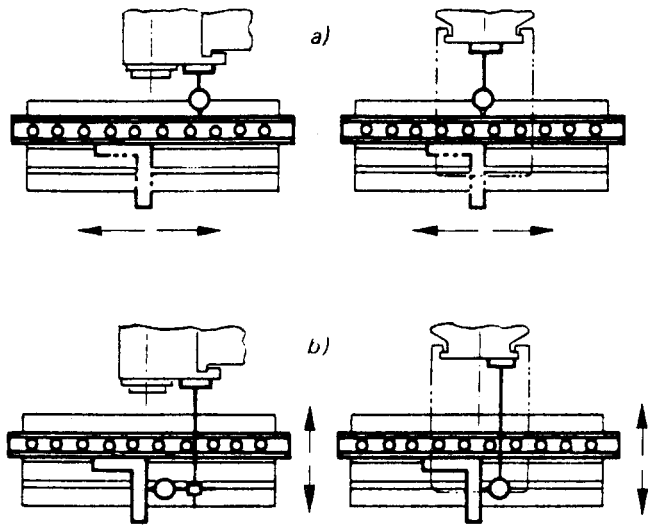
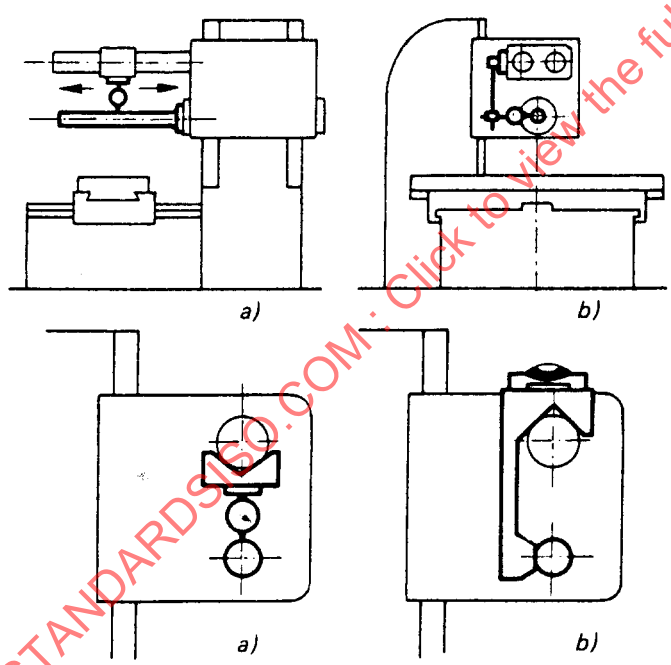
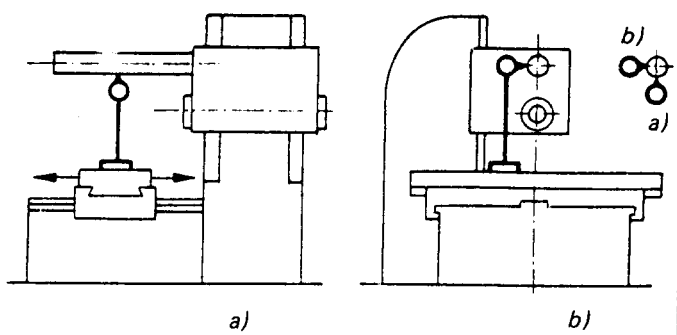
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,04 up to 1000 For each 1 000 mm increase in length, add 0,005 Maximum permissible deviation : 0,05 Local tolerance : 0,02 for any measuring length of 300	0.0016 up to 40 For each 40 in increase 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.
a) 0,025 for any measuring length of 300 *b)* 0,025 for any measuring length of 300 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.
a) 0,01 *b)* 0,01 *c)* 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		Measurement of run-out of the internal taper of the spindle : *a)* near the mouth of taper; *b)* at a distance of 300 mm (12 in) from the spindle nose.
G 7		Verification of parallelism of the spindle axis to the table surface (for horizontal spindle machines only).
G 8		Verification of squareness of the spindle axis to the table surface (for vertical spindle machines only) : *a)* in the vertical plane of symmetry of the machine; *b)* in the plane perpendicular to the vertical plane of symmetry of the machine.

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

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

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
a) 0,025 for a measuring length of 300 (free end of the test mandrel inclined downwards) *b)* • 0,025 for a measuring length of 300	*a)* 0.001 for a measuring length of 12 (free end of the test mandrel inclined downwards) *b)* 0.001 for a measuring length of 12	Dial gauge and test mandrel	Clause 5.422.3. Table in central position, spindle head slide locked.
0,01 for any measuring length of 500 Maximum permissible deviation : 0,03	0.0004 for any measuring length of 20 Maximum permissible deviation : 0.001 2	Straightedge and dial gauge or slip gauges, or taut wire and microscope	Clauses 5.212, 5.212.1, 5.212.3 or 5.232. The straightedge may be placed directly on the table.
0,02/300*	0.0008/12*	Dial gauge	Clauses 5.512.1 and 5.512.52. Table in central position. Table, cross slide and spindle head slide locked. • Distance between the two points touched.
0,015 for any measuring length of 300 Maximum permissible deviation : 0,04	0.0006 for any measuring length of 12 Maximum permissible deviation : 0.0016	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 spindle cannot be locked, then the dial gauge shall be placed on a fixed part of the machine.

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

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,02/300	0.0008/12	Straightedge, dial gauge and square	Clause 5.522.4. *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. *b)* The table transverse movement shall then be checked. 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) 0,02 for a measuring length of 300 (over arm inclined downwards) *b)* 0,02 for a measuring length of 300	*a)* 0.0008 for a measuring length of 12 (over arm inclined downwards) *b)* 0.0008 for a measuring length of 12	Dial gauge and possibly precision level	Clause 5.412.5 or clauses 5.412.1 and 5.412.3. Clause 5.422.4. Over arm(s) locked.
a) 0,02 for a measuring length of 300 (over arm inclined downwards) *b)* 0,02 for a measuring length of 300	*a)* 0.0008 for a measuring length of 12 (over arm inclined downwards) *b)* 0.0008 for a measuring length of 12		