

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 1986

TEST CONDITIONS
FOR SURFACE GRINDING MACHINES
WITH HORIZONTAL GRINDING WHEEL SPINDLE AND RECIPROCATING TABLE

TESTING OF ACCURACY

1st EDITION

November 1971

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**TEST CONDITIONS
FOR SURFACE GRINDING MACHINES
WITH HORIZONTAL GRINDING WHEEL SPINDLE AND RECIPROCATING TABLE**

TESTING OF ACCURACY

1. SCOPE

This ISO Recommendation describes, with reference to ISO Recommendation R 230, *Machine tool test code*, both geometrical and practical tests on general purpose and normal accuracy surface grinding machines with reciprocating table and horizontal grinding wheel spindle and the corresponding permissible deviations which apply.

This ISO Recommendation is not applicable to surface grinding machines with fixed or rotating tables or to machines having longitudinal traverse of the wheelhead.*

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

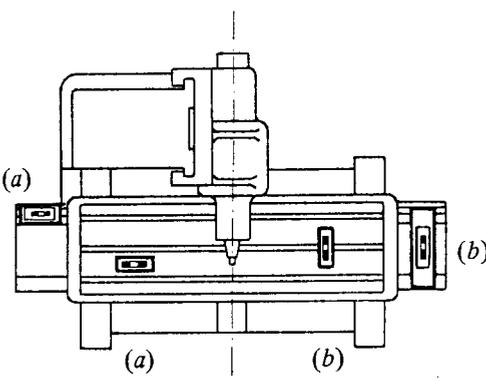
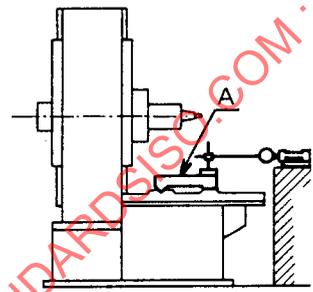
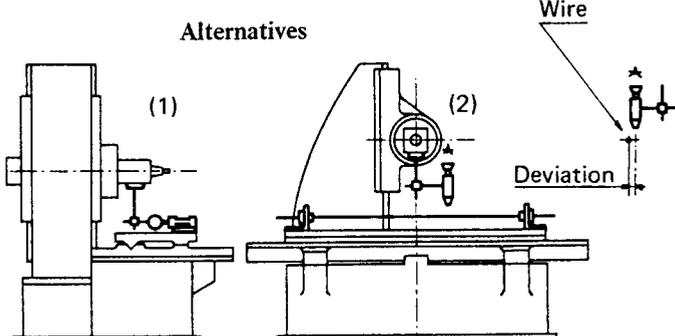
2. PRELIMINARY REMARKS

- 2.1 In this ISO Recommendation, all the dimensions are expressed in millimetres and in inches.
- 2.2 To apply this ISO Recommendation, reference should be made to ISO Recommendation R 230, especially for the installation of the machine before testing, warming up of spindles and other moving parts, description of measuring methods and recommended accuracy of testing equipment.
- 2.3 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and this, in no way, defines the practical order of testing. In order to make the mounting of instruments or gauging easier, tests may be applied in any order.
- 2.4 When inspecting a machine, it is not always necessary to carry out all the tests described in this ISO Recommendation. It is up to the user to choose, in agreement with the manufacturer, those tests relating to the properties which are of interest to him, but these tests are to be clearly stated when ordering a machine.
- 2.5 Practical tests should be made with finishing cuts.
- 2.6 When the tolerance is established for a measuring range different from that given in this ISO Recommendation (see clause 2.311 in ISO Recommendation R 230), it should be taken into consideration that the minimum value of tolerance is 0.001 mm (0.00004 in) for geometrical tests and practical tests.

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

3. TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

3.1 Geometrical tests

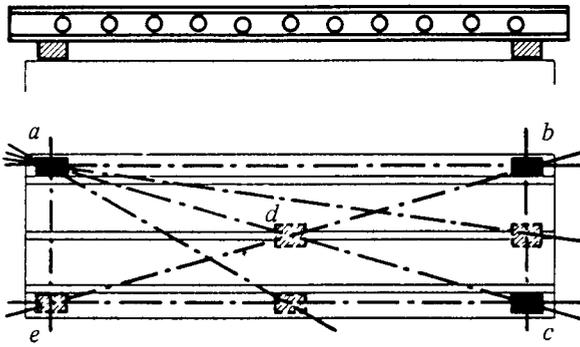
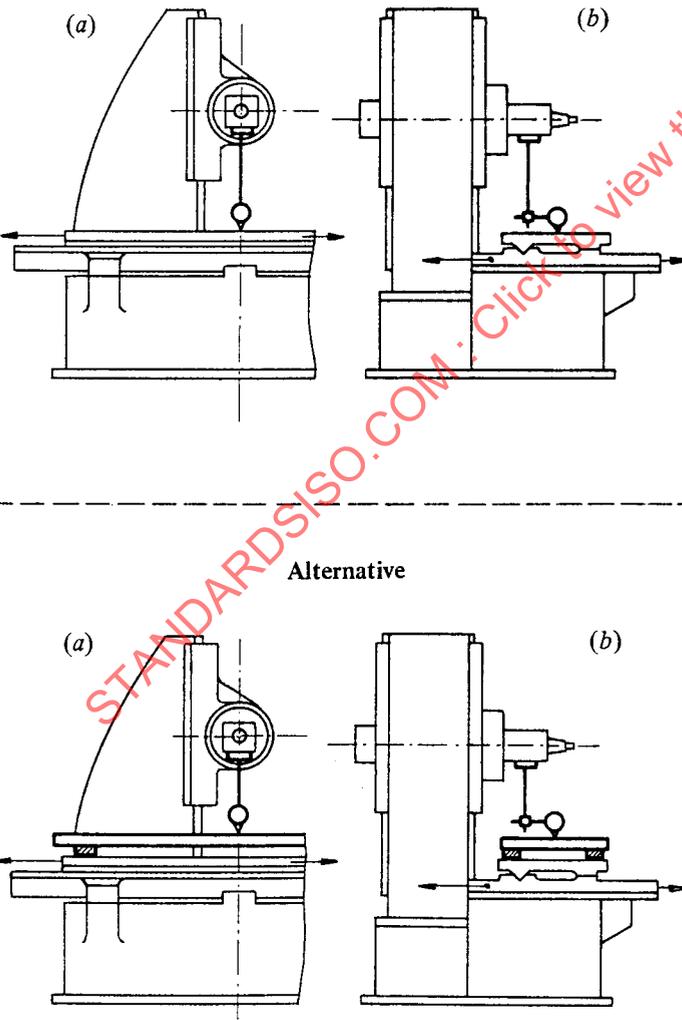
No.	Diagram	Object	
G 1		<p>Verification of levelling of slideways :</p> <p>(a) longitudinal verification : – straightness of slideways in the vertical plane.</p> <p>(b) transverse verification : – slideways should be in the same plane.</p>	<p>(a) 0.02 u For ex crease</p> <p>Maxim deviat</p> <p>(b) Variat 0.0</p>
G 2		<p>Verification of straightness of slideways in a horizontal plane.</p>	<p>0.02 u For each 1 in length, ad</p> <p>Maximum viation :</p> <p>Local tolera</p> <p>over any 1 of 300</p>
	<p>Alternatives</p> 	<p>(These alternatives are for small machines where the table is not to be dismantled.)</p> <p>Verification of the straightness of the longitudinal movement of the table.</p>	<p>0.01 u For each 1 in length, ad</p> <p>Maximum viation :</p>

5-6 d)

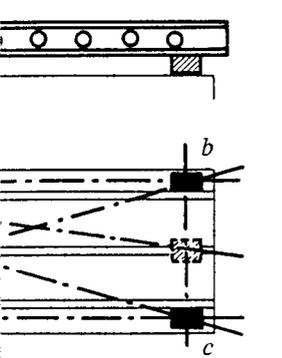
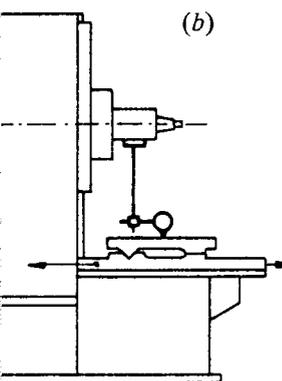
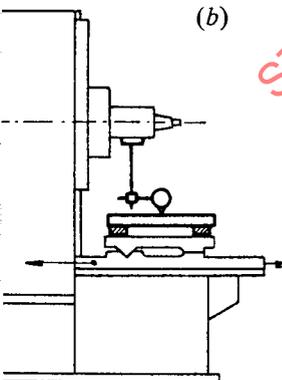
Object	Permissible deviation		Measuring instrument
	mm	in	
Verification of levelling of slideways : (a) longitudinal verification : — straightness of slideways in the vertical plane.	(a) 0.02 up to 1000 For each 1000 mm increase in length, add 0.015 Maximum permissible deviation : 0.05	(a) 0.0008 up to 40 For each 40 in increase in length, add 0.0006 Maximum permissible deviation : 0.002	Precision levels, or other methods
(b) transverse verification : — slideways should be in the same plane.	(b) Variation of level : 0.02/1000	(b) Variation of level : 0.0008/40	
Verification of straightness of slideways in a horizontal plane.	0.02 up to 1000 For each 1000 mm increase in length, add 0.02 Maximum permissible deviation : 0.05 Local tolerance : 0.01 over any measuring length of 300	0.0008 up to 40 For each 40 in increase in length, add 0.0008 Maximum permissible deviation : 0.002 Local tolerance : 0.0004 over any measuring length of 12	Straightedge, surface gauge and dial gauge or wire and microscope
(These alternatives are for small machines where the table is not to be dismantled.) Verification of the straightness of the longitudinal movement of the table.	0.01 up to 1000 For each 1000 mm increase in length, add 0.01 Maximum permissible deviation : 0.025	0.0004 up to 40 For each 40 in increase in length, add 0.0004 Maximum permissible deviation : 0.001	

5-6b)

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0.02 up to 1000 For each 1000 mm increase in length, add 0.015 Maximum permissible deviation : 0.05	(a) 0.0008 up to 40 For each 40 in increase in length, add 0.0006 Maximum permissible deviation : 0.002	Precision levels, optical or other methods	(a) Clauses 3.11, 3.21, 5.212.21 and 5.212.22 Measurements should be made at a number of positions equally spaced along the length of the slideways. For machines standing on three support points or having a table travel less than 1500 mm (60 in) the table need not be removed. In this case the level should be placed successively on the exposed portions of the slideways and on the table. The table should be in its central position.
Variation of level : 0.02/1000	(b) Variation of level : 0.0008/40		(b) Clause 5.412.7 A level should be placed transversely on the slideways, and measurements should be taken at a number of positions equally spaced along the length of the slideway. The variation of level measured at any position should not exceed the permissible deviation.
0.02 up to 1000 For each 1000 mm increase in length, add 0.02 Maximum permissible deviation : 0.05 Local tolerance : 0.01 over any measuring length	0.0008 up to 40 For each 40 in increase in length, add 0.0008 Maximum permissible deviation : 0.002 Local tolerance : 0.0004 over any measuring length of 12	Straightedge, support and dial gauge or taut wire and microscope	Clause 5.232.1 The dial gauge should be fixed on a support A of a suitable form such that it can slide in the slideways with the stylus touching a straightedge laid parallel to the slideways.
0.01 up to 1000 For each 1000 mm increase in length, add 0.01 Maximum permissible deviation : 0.025	0.0004 up to 40 For each 40 in increase in length, add 0.0004 Maximum permissible deviation : 0.001		Clauses 5.232.1 or 5.212.3 – 5.232.2 Alternative (1) The dial gauge support should be placed on a fixed part of the machine, the stylus touching a straightedge laid parallel to the general direction of the longitudinal movement of the table.

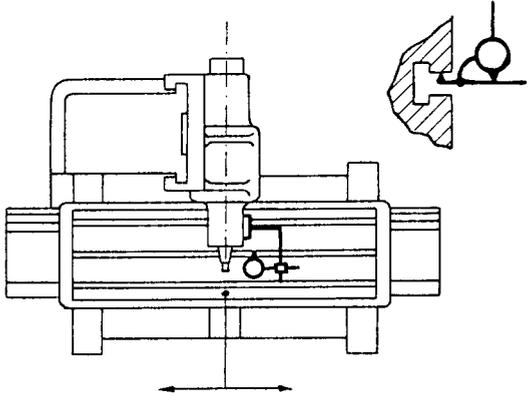
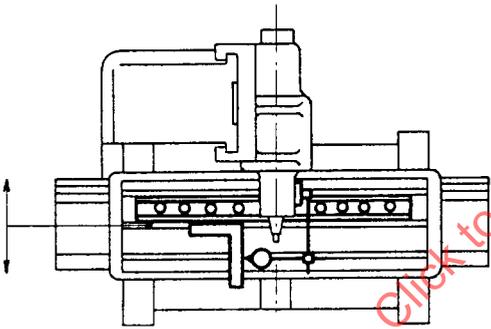
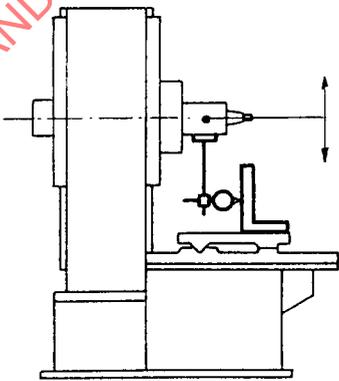
No.	Diagram	Object	
G 3		<p>Verification of flatness of the table surface.</p>	<p>0.01</p> <p>For each in length, ϵ</p> <p>Maximum deviation :</p> <p>Local tolerances</p> <p>over any of 300</p>
G 4	<p>Alternative</p> 	<p>Verification of parallelism of the table surface :</p> <p>(a) to its longitudinal movement;</p> <p>(b) to its transverse movement or to the transverse movement of the wheelhead.</p>	<p>(a) 0.01</p> <p>For creases</p> <p>Maximum deviation</p> <p>Local tolerances</p> <p>over length</p> <p>(b) 0.01</p> <hr/> <p>(a) 0.01</p> <p>For creases</p> <p>Maximum deviation</p> <p>(b) 0.01</p>

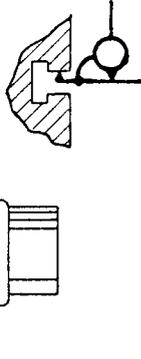
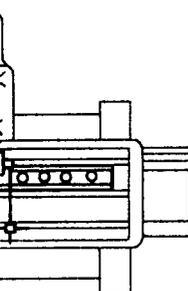
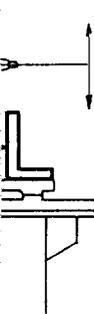
7-8a)

	Object	Permissible deviation	
		mm	in
	Verification of flatness of the table surface.	0.01 up to 1000 For each 1000 mm increase in length, add 0.01 Maximum permissible deviation : 0.04 Local tolerance : 0.005 over any measuring length of 300	0.0004 up to 40 For each 40 in increase in length, add 0.0004 Maximum permissible deviation : 0.0016 Local tolerance : 0.0002 over any measuring length of 12
	Verification of parallelism of the table surface : (a) to its longitudinal movement;	(a) 0.015 up to 1000 For each 1000 mm increase in length, add 0.01 Maximum permissible deviation : 0.05 Local tolerance : 0.008 over any measuring length of 300	(a) 0.0006 up to 40 For each 40 in increase in length, add 0.0004 Maximum permissible deviation : 0.002 Local tolerance : 0.0003 over any measuring length of 12
	(b) to its transverse movement or to the transverse movement of the wheelhead.	(a) 0.01 up to 1000 For each 1000 mm increase in length, add 0.005 Maximum permissible deviation : 0.035 (b) 0.01 up to 1000	(a) 0.0004 up to 40 For each 40 in increase in length, add 0.0002 Maximum permissible deviation : 0.0014 (b) 0.0004 up to 40

7-8 n)

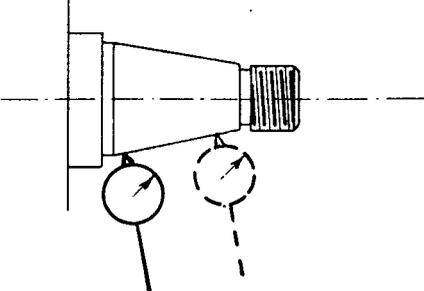
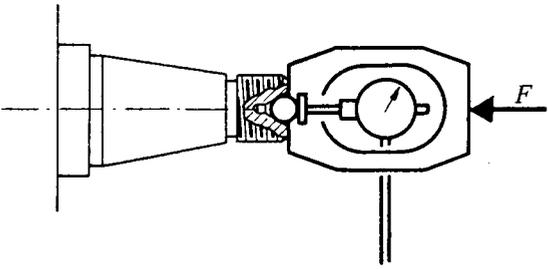
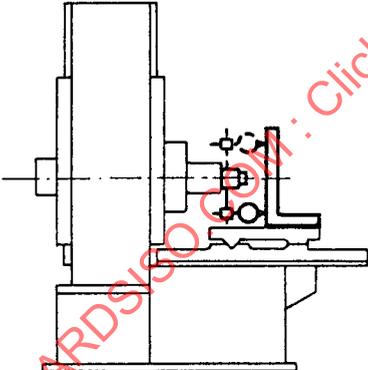
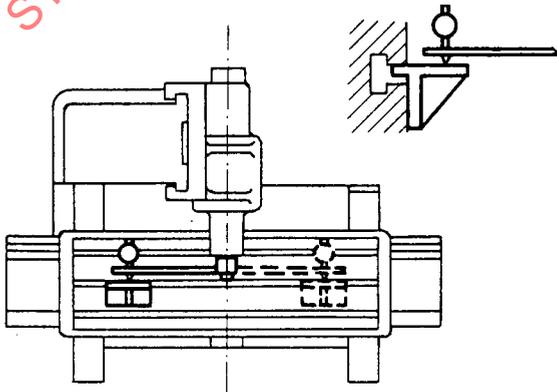
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0.01 up to 1000 For each 1000 mm increase in length, add 0.01 Maximum permissible deviation : 0.04 Local tolerance : 0.005 over any measuring length	0.0004 up to 40 For each 40 in increase in length, add 0.0004 Maximum permissible deviation : 0.0016 Local tolerance : 0.0002 over any measuring length of 12	Straightedge and slip gauges or precision level	Clauses 5.322 and 5.323 The table should be positioned at the centre of travel. The table should not be locked.
0.015 up to 1000 For each 1000 mm increase in length, add 0.01 Maximum permissible deviation : 0.05 Local tolerance : 0.008 over any measuring length of 300	(a) 0.0006 up to 40 For each 40 in increase in length, add 0.0004 Maximum permissible deviation : 0.002 Local tolerance : 0.0003 over any measuring length of 12	Dial gauge	Clause 5.422.21 1. Checking by direct contact with the table. 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. The stylus to be placed approximately in the wheel spindle axis.
0.01 up to 1000 For each 1000 mm increase in length, add 0.005 Maximum permissible deviation : 0.035 over any measuring length	(a) 0.0004 up to 40 For each 40 in increase in length, add 0.0002 Maximum permissible deviation : 0.0014 (b) 0.0004 up to 40	Dial gauge and precision straightedge	2. Checking with a straightedge. It is unnecessary to follow the test code ISO/R 230. The checking should be made on a straightedge laid parallel to the table surface and placed in the direction of the movement concerned.

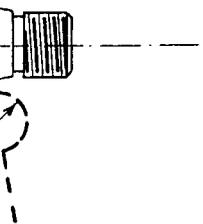
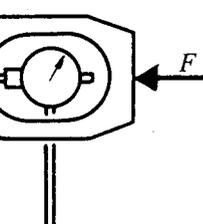
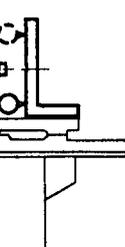
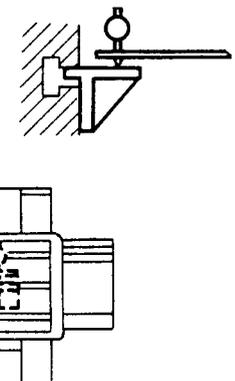
No.	Diagram	Object	
G 5		<p>Verification of parallelism of the median or reference tee slot to the longitudinal movement of the table.</p>	<p>0.01</p> <p>For each in length, l</p> <p>Maximum viation :</p> <p>Local tol</p> <p>over any of 300</p>
G 6		<p>Verification of squareness of the longitudinal movement of the table to its transverse movement or to the wheelhead movement.</p>	
G 7		<p>Verification of squareness and straightness of the vertical movement of the wheelhead of the table surface in a transverse vertical plane.</p>	

	Object	Permissible deviation	
		mm	in
	<p>Verification of parallelism of the median or reference tee slot to the longitudinal movement of the table.</p>	<p>0.015 up to 1000 For each 1000 mm increase in length, add 0.01 Maximum permissible deviation : 0.05 Local tolerance : 0.008 over any measuring length of 300</p>	<p>0.0006 up to 40 For each 40 in increase length, add 0.0004 Maximum permissible deviation : 0.002 Local tolerance : 0.0003 over any measuring length of 12</p>
	<p>Verification of squareness of the longitudinal movement of the table to its transverse movement or to the wheelhead movement.</p>	<p>0.03/300</p>	<p>0.0012/12</p>
	<p>Verification of squareness and straightness of the vertical movement of the wheelhead of the table surface in a transverse vertical plane.</p>	<p>0.04/300</p>	<p>0.0016/12</p>

g-10 b)

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0.015 up to 1000 For each 1000 mm increase in length, add 0.01 Maximum permissible de- viation : 0.05 Local tolerance : 0.008 over any measuring length	0.0006 up to 40 For each 40 in increase in length, add 0.0004 Maximum permissible de- viation : 0.002 Local tolerance : 0.0003 over any measuring length of 12	Dial gauge	Clauses 5.422.1 and 5.422.21 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.
0.03/300	0.0012/12	Straightedge, square and dial gauge	Clause 5.522.4 (a) Place the straightedge parallel to the longitudinal movement of the table and then place the table in its central position. (b) Place the square in contact with the straightedge. (c) Check the transverse movement of the table or the wheelhead.
0.04/300	0.0016/12	Dial gauge and square	Clause 5.522.2 Clamp the wheelhead if possible when taking measurements. If the spindle can be locked, the dial gauge can be mounted on it. If the spindle cannot be locked, the dial gauge should be placed on a fixed part of the wheelhead.

No.	Diagram	Object
G 8		<p>Measurement of run-out of the wheel spindle nose.</p>
G 9		<p>Measurement of periodical axial slip of the wheel spindle.</p>
G 10		<p>Verification of parallelism of the axis of the wheel spindle to the table surface.</p>
G 11		<p>Verification of squareness of the axis of the wheel spindle to the median or reference tee slot of the table.</p>

	Object	Permissible deviation	
		mm	in
	Measurement of run-out of the wheel spindle nose.	0.01	0.0004
	Measurement of periodical axial slip of the wheel spindle.	0.01	0.0004
	Verification of parallelism of the axis of the wheel spindle to the table surface.	0.025/300	0.001/12
	Verification of squareness of the axis of the wheel spindle to the median or reference tee slot of the table.	0.015/300*	0.0006/12*

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
m	in		
01	0.0004	Dial gauge	<p>Clauses 5.612.1 and 5.612.2</p> <p>The stylus of the dial gauge should be set normal to the surface which is to be checked. Checking should be carried out at each extremity of the taper. This is not stated in the test code ISO/R 230.</p>
01	0.0004	Dial gauge	<p>Clauses 5.622.1 and 5.622.2</p> <p>A force F, specified by the manufacturer of the machine, should be exerted co-axially with the spindle.</p> <p>The line of action of the stylus of the dial gauge should be co-axial with the spindle.</p>
/300	0.001/12	Dial gauge and square	<p>Clauses 5.512.1 and 5.512.42</p> <p>Table in central position.</p> <p>Wheelhead clamped when taking measurements.</p>
/300*	0.0006/12*	Dial gauge and square	<p>Clauses 5.512.1 and 5.512.42</p> <p>Table in central position.</p> <p>Wheelhead clamped when taking measurements.</p> <p>* Distance between the two points touched.</p>