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# INTERNATIONAL STANDARD



# 2433

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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## Test conditions for external cylindrical grinding machines with a movable table — Testing of accuracy

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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.

International Standard ISO 2433 was drawn up by Technical Committee ISO/TC 39, *Machine tools*, and circulated to the Member Bodies in January 1972.

It has been approved by the Member Bodies of the following countries :

Belgium	Netherlands	Thailand
Czechoslovakia	Poland	Turkey
Egypt, Arab Rep. of	Portugal	United Kingdom
France	Romania	U.S.A.
Hungary	South Africa, Rep. of	U.S.S.R.
Ireland	Sweden	
Italy	Switzerland	

The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Germany  
India  
Japan

# Test conditions for external cylindrical grinding machines with a movable table — Testing of accuracy

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard describes, with reference to ISO/R 230, *Machine tool test code*, both geometrical and practical tests on general purpose and normal accuracy external cylindrical grinding machines with a movable table<sup>1)</sup> of which the swing diameter does not exceed 800 mm (32 in) and the distance between centres, 4 000 mm (160 in), and also gives the corresponding permissible deviations which apply.

It deals only with the verification of accuracy of the machine. It does not apply to the testing of the running of the machine (vibrations, abnormal noises, stick-slip motion of components, etc.), or to its 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 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 International Standard. 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.

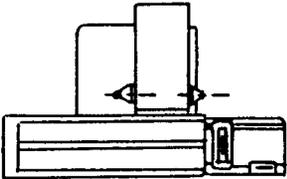
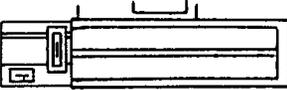
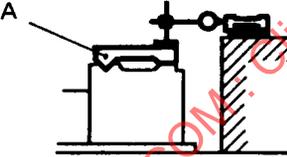
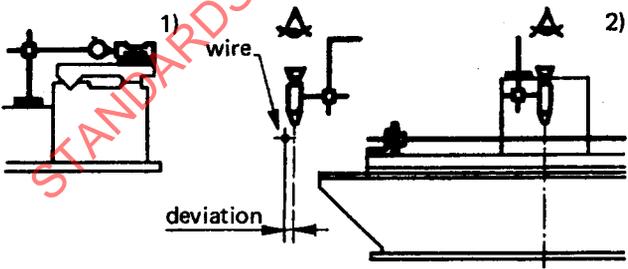
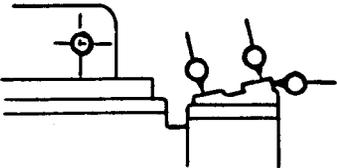
2.5 Practical tests shall be made with finishing cuts and not with roughing cuts which are liable to generate appreciable cutting forces.

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 0.001 mm (0.000 04 in).

1) This International Standard does not apply to machines having a fixed table and a movable wheelhead.

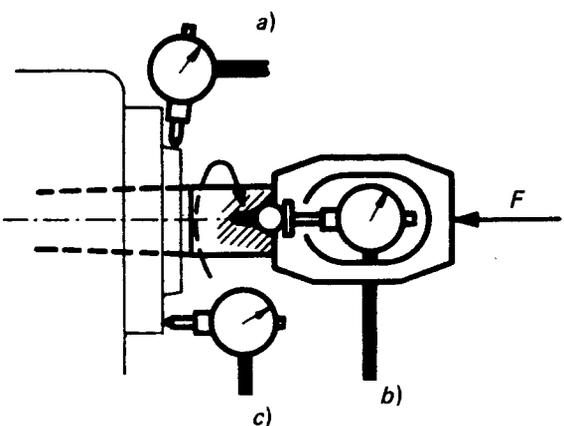
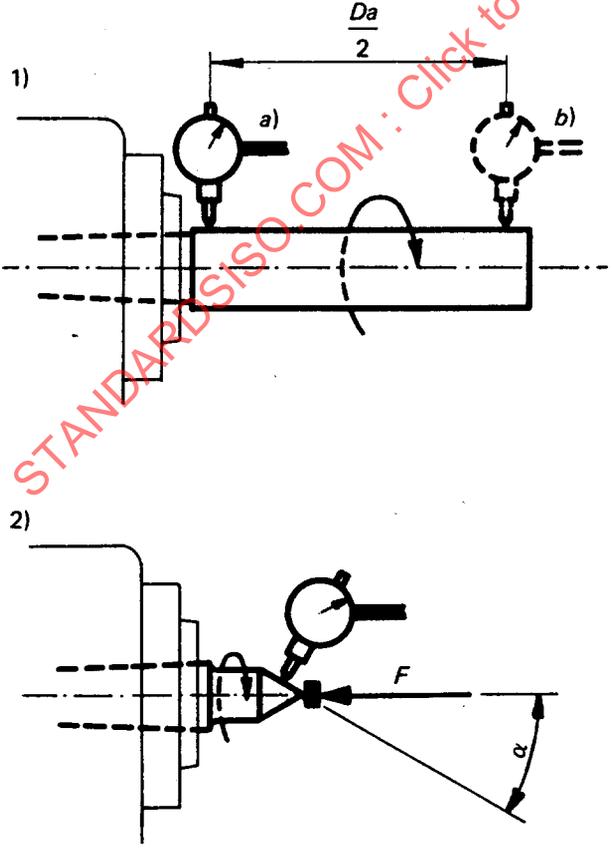
3. TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

3.1 Geometrical tests

No.	Diagram	Object	
G 1a		<p><b>A – BED</b></p> <p>Levelling of the slideways</p> <p>a) Longitudinal inspection :</p> <p>Straightness of the slideways in the vertical plane;</p>	<p>0,0;</p> <p>For each 100 add</p> <p>0,0;</p> <p>Maximum pe</p> <p>0,0;</p> <p>Local toleran</p> <p>0,00</p> <p>over any leng</p>
G 1b		<p>b) Transverse inspection :</p> <p>Parallelism of the slideways in the vertical plane.</p>	<p>Variatio</p> <p><math>DC^* \leq !</math></p> <p><math>DC^* &gt; !</math></p>
G 2	 <p>Alternatives</p> 	<p>Checking of straightness of the slideways in a horizontal plane.</p>	<p>0,02</p> <p>For each 100 add:</p> <p>0,02</p> <p>Maximum pe</p> <p>0,0E</p> <p>Local toleran</p> <p>0,00</p> <p>over any leng</p>
	<p>1) wire</p> <p>deviation</p> <p>2)</p>	<p>(These alternatives are for small machines where the table is not to be dismantled.)</p> <p>Checking of straightness of the longitudinal movement of the table in the horizontal plane.</p>	<p>0,01</p> <p>For each 100 add:</p> <p>0,01</p> <p>Maximum pe</p> <p>0,02</p>
G 3		<p>Checking of parallelism of the location surfaces for the workhead and tailstock to the longitudinal movement of the table (in the case of movable tables).</p>	<p>0,01</p> <p>For each 100 add:</p> <p>0,01</p> <p>Maximum pe</p> <p>0,03</p> <p>Local toleran</p> <p>0,00</p> <p>over any leng</p>

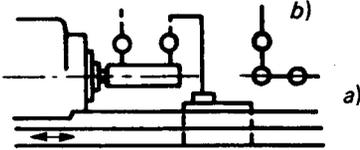
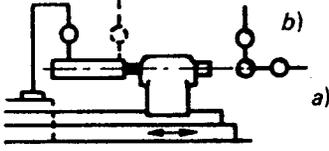
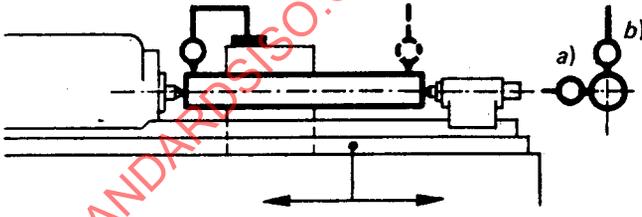
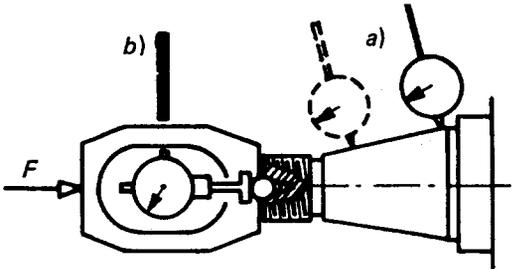
\* DC = distance between centres.

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,02 up to 1000 For each 1000 increase in length, add: 0,015 Maximum permissible deviation: 0,05 Local tolerance: 0,005 over any length of 250	0.0008 up to 40 For each 40 increase in length, add: 0.0006 Maximum permissible deviation: 0.002 Local tolerance: 0.0002 over any length of 10	Precision level, optical or other methods	a) Clauses 3.11, 3.21, 5.212.21 and 5.212.22 Measurements shall be made at a number of positions equally spaced along the length of the bed. For machines standing on three support points or having a distance between centres less than 1 000 mm (40 in) the table need not be removed. In this case the level shall be placed suc- cessively on the exposed portions of the slideways and on the table. The table should be in its central posi- tion.
Variation of level : * ≤ 500 : 0,02/1000 * > 500 : 0,04/1000	Variation of level : DC* ≤ 20 : 0.0008/40 DC* > 20 : 0.0016/40	Precision level	b) Clause 5.412.7 A level shall be placed transversely on the slideways, and measurements shall be taken at a number of positions equally spaced along the length of the bed. The variation of level measured at any posi- tion shall not exceed the permissible devi- ation.
0,02 up to 1000 For each 1000 increase in length, add: 0,02 Maximum permissible deviation: 0,05 Local tolerance: 0,006 over any length of 300	0.0008 up to 40 For each 40 increase in length, add: 0.0008 Maximum permissible deviation: 0.002 Local tolerance: 0.00024 over any length of 12	Straightedge, support and dial gauge or micro- scope and taut wire	Clause 5.232.1  The dial gauge shall 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 slide- ways.
0,01 up to 1000 For each 1000 increase in length, add: 0,01 Maximum permissible deviation: 0,025	0.0004 up to 40 For each 40 increase in length, add: 0.0004 Maximum permissible deviation: 0.001		Clauses 5.232.1 or 5.232.2  For Alternative 1) the dial gauge support shall be placed on a fixed part of the machine, the stylus shall touch a straight- edge laid parallel to the general direction of the longitudinal movement of the table.
0,01 up to 1000 For each 1000 increase in length, add: 0,01 Maximum permissible deviation: 0,03 Local tolerance: 0,003 over any length of 300	0.0004 up to 40 For each 40 increase in length, add: 0.0004 Maximum permissible deviation: 0.0012 Local tolerance: 0.00012 over any length of 12	Dial gauge(s)	Clause 5.422.22  Place a dial gauge (s) on a fixed part of the machine and take measurements suc- cessively on the location surfaces for the workhead and the tailstock.  The table setting carried out during this test shall not be modified for performing tests G 6, G 7 and G 8.

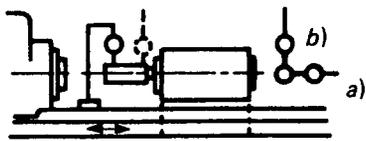
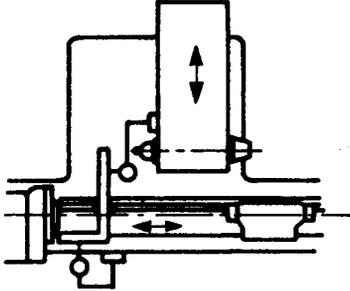
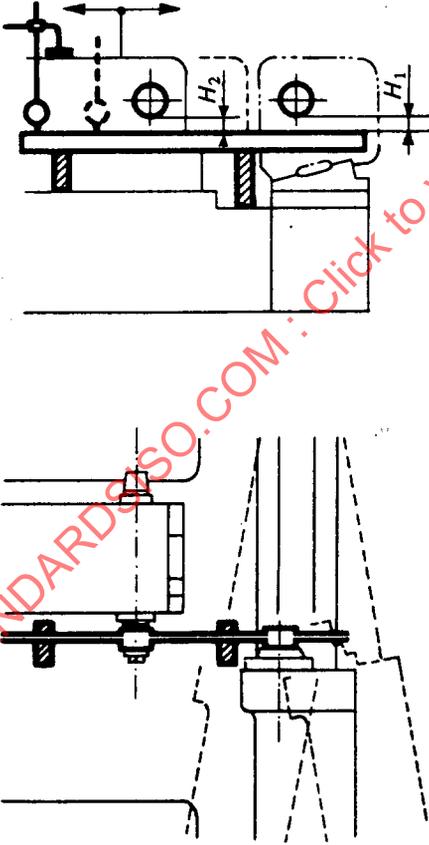
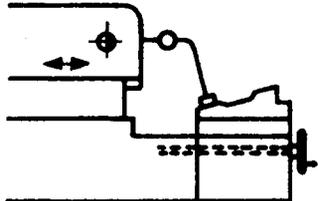
No.	Diagram	Object	
G 4		<p align="center"><b>B – WORKHEAD</b></p> <p>(Tests G 4 and G 5 apply only to machines having a rotating spindle.)</p> <p>a) Measurement of run-out of the external register diameter of the spindle;</p> <p>b) Measurement of periodic axial slip of the spindle;</p> <p>c) Measurement of camming of the register face of the spindle (including periodic axial slip).</p>	<p>a)</p> <p>b)</p> <p>c)</p>
G 5		<p>1) Measurement of run-out of the axis of the workspindle taper:</p> <p>a) at the outlet of the housing;</p> <p>b) at a distance from the outlet equal to <math>\frac{Da^*}{2}</math> or not more than 300 mm (12 in).</p> <p>2) Measurement of run-out of the workspindle centre nose.</p>	<p>1)</p> <p>a)</p> <p>b) for of 3</p> <p>2)</p>

\*  $Da$  = Maximum diameter admissible for grinding.

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
a) 0,005	a) 0.0002	Dial gauge	a) Clause 5.612.2  In the case of a tapered spindle nose the stylus of the dial gauge shall be set normal to the surface which is to be checked.
b) 0,005	b) 0.0002		b) and c) Clauses 5.62, 5.621.2, 5.622.1, 5.622.2 and 5.632  For the dial gauge position, see Figures 59 to 64 and 67, clauses 5.62, 5.622 and 5.632.
c) 0,01	c) 0.0004		The value of force $F$ to be applied for the tests a), b) and c) shall be specified by the manufacturer.
a) 0,005	a) 0.0002	Dial gauge and test mandrel	Clause 5.612.3
b) 0,015 for a measuring length of 300	b) 0.0006 for a measuring length of 12		
a) 0,005	2) 0.0002	Dial gauge	Clause 5.612.2  The dial gauge being set normal to the taper surface of the head centre, and tolerance being given in a plane perpendicular to the spindle axis, the readings observed shall therefore be divided by $\cos \alpha$ , $\alpha$ being the semi-cone angle of the taper. The value of force $F$ to be applied shall be specified by the manufacturer.

No.	Diagram	Object	
G 6		<p>1) Dead spindle</p> <p>Checking of parallelism of the taper bore of the workhead to the table movement :</p> <p>a) in a horizontal plane;</p> <p>b) in a vertical plane.</p>	<p>for a meas (end of th rected tow wards)</p>
		<p>2) Live spindle</p> <p>Checking of parallelism of the axis of the rotating workhead spindle to the longitudinal movement of the table :</p> <p>a) in a horizontal plane;</p> <p>b) in a vertical plane.</p>	<p>for a meas (end of te towards w</p>
G 7		<p><b>C – TAILSTOCK</b></p> <p>Checking of parallelism of the axis of taper bore of the tailstock to the table movement :</p> <p>a) in a horizontal plane;</p> <p>b) in a vertical plane.</p>	<p>a) for of 3 (end dire</p> <p>b) for of 3 (end dire</p>
G 8		<p>Checking of parallelism of the movement of the table to the axis of the centres :</p> <p>a) in the horizontal plane;</p> <p>b) in the vertical plane.</p>	<p>a)</p> <p>b) (tail the</p>
G 9		<p><b>D – GRINDING WHEEL HEAD</b></p> <p>a) Measurement of run-out of the grinding wheel spindle (wheel mounting diameter);</p> <p>b) Measurement of periodic axial slip of the wheel spindle.</p>	<p>a) for</p> <p>b)</p>

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,025 measuring length of 300 of the test mandrel di- rected towards wheel and up- wards)	0.001 for a measuring length of 12 (end of the test mandrel di- rected towards wheel and up- wards)	Dial gauge and test mandrel	Clauses 5.412.1 and 5.422.3  The table setting established for test G 3 must not be modified.
0,01 measuring length of 300 of test mandrel directed towards wheel and upwards)	0.0004 for a measuring length of 12 (end of test mandrel directed towards wheel and upwards)		
0,015 for a measuring length of 300 (end of test mandrel directed towards wheel)	a) 0.0006 for a measuring length of 12 (end of test mandrel directed towards wheel)	Dial gauge and test mandrel	Clauses 5.412.1 and 5.422.3  The table setting established for test G 3 must not be modified.
0,015 for a measuring length of 300 (end of test mandrel directed upwards)	b) 0.0006 for a measuring length of 12 (end of test mandrel directed upwards)		
0,02  0,02 (tailstock higher than the workhead)	a) 0.0008  b) 0.0008 (tailstock higher than the workhead)	Dial gauge and test mandrel between cen- tres (or straightedge) or optical methods	Clauses 5.232.1 or 5.232.3 Clauses 5.212.3 and 5.232.3 b)  The table setting established for test G 3 must not be modified.
0,005 for the two sections touched.	a) 0.0002 for the two sections touched.	Dial gauge	a) Clauses 5.612.2 and 5.621.2  See the observations for test G 4. The measurement of the run-out shall be carried out at the two ends of the taper.  b) Clauses 5.62, 5.621.2, 5.622.1, 5.622.2 and 5.632  The value of force <i>F</i> to be applied for the tests a) and b) shall be specified by the manufacturer.
b) 0,01	b) 0.0004		

No.	Diagram	Object	
G 10		<p>Checking of parallelism of the grinding wheel spindle axis to the table movement :</p> <p>a) in a horizontal plane;</p> <p>b) in a vertical plane.</p>	<p>a) for of</p> <p>b) for of (en dir</p>
G 11		<p>Checking of squareness of the in feed motion of the wheelhead to the longitudinal movement of the table.</p>	
G 12		<p>Measurement of difference between height <math>H_1</math> of the workhead spindle axis and the height <math>H_2</math> of the grinding wheel spindle axis referred to a plane parallel to the grinding wheel spindle axis and also parallel to the transverse movement of the wheelhead slide.</p>	
		<p>Extra test in the case of swivelling tables</p> <p>Checking of parallelism of the mounting and swivelling plane to the transverse movement of the wheel slide.</p>	<p>over t</p>
G 13		<p>Measurement of accuracy of repetition of the finishing approach of the wheel positioning.</p>	<p><math>D_a</math></p> <p><math>D_a</math></p>

\*  $D_a$  = Maximum diameter admissible for grinding.