
INTERNATIONAL STANDARD



1708

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

Test conditions for general purpose parallel lathes — Testing of the accuracy

Conditions d'essai des tours parallèles d'usage général — Contrôle de la précision

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Descriptors : machine tools, lathes, 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.

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 1708 and found it technically suitable for transformation. International Standard ISO 1708 therefore replaces ISO Recommendation R 1708-1970 to which it is technically identical.

ISO Recommendation R 1708 was approved by the Member Bodies of the following countries :

Australia	India	South Africa, Rep. of
Austria	Israel	Spain
Belgium	Italy	Sweden
Brazil	Japan	Switzerland
Chile	Korea, Rep. of	Thailand
Czechoslovakia	Netherlands	Turkey
France	New Zealand	United Kingdom
Germany	Poland	U.S.A.
Greece	Portugal	
Hungary	Romania	

No Member Body expressed disapproval of the Recommendation.

No Member Body disapproved the transformation of ISO/R 1708 into an International Standard.

Test conditions for general purpose parallel lathes – Testing of the accuracy

1 SCOPE AND FIELD OF APPLICATION

This International Standard describes, with reference to ISO/R 230, both geometrical and practical tests on general purpose parallel lathes, and 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 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 shall be made to ISO/R 230, especially for installation of the machine before testing, warming up of spindles and other moving 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 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.

3.4 When inspecting a machine, it is not always necessary to carry out all the tests given 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 the agreed tests shall be clearly stated when ordering a machine.

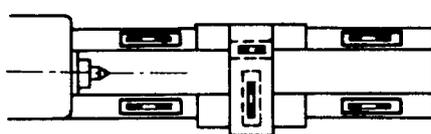
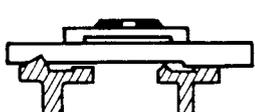
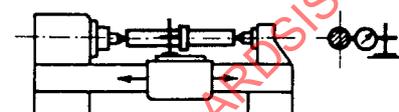
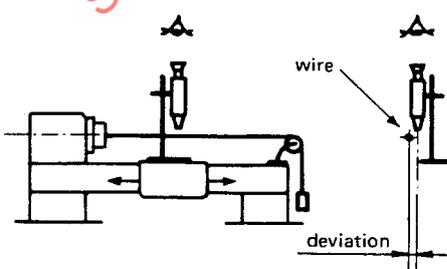
3.5 Practical tests should be made with finishing cuts – for instance, depth = 0,1 mm (0.004 in); feed = 0,1 mm (0.004 in) per revolution – and not with roughing cuts, which are liable to generate appreciable cutting forces.

3.6 When establishing the tolerance for a measuring range different from that indicated 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 0,005 mm (0.0002 in) for precision lathes and 0,010 mm (0.0004 in) for other lathes.

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4 TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

4.1 Geometrical tests

No.	Diagram	Object	Precision lathes	
			mm	in
			$D_a \leq 500$ and $DC \leq 1500$	$D_a \leq 20$ and $DC \leq 60$
G 1	<p>a)</p>  <p>b)</p> 	<p>A – BED</p> <p>Verification of levelling of slide-ways</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>	$DC \leq 500$ 0,01 (convex)	$DC \leq 20$ 0.0004 (convex)
			$500 < DC \leq 1000$ 0,015 (convex) Local tolerance** : 0,005 for any length of 250	$20 < DC \leq 40$ -0.0006 (convex) Local tolerance** : 0.0002 for any length of 10
			$1000 < DC \leq 1500$ 0,02 (convex) Local tolerance ** : 0,005 for any length of 250	$40 < DC \leq 60$ 0.0008 (convex) Local tolerance** : 0.0002 for any length of 10
			Local tolerance ** : 0,005 for any length of 250	Local tolerance** : 0.0002 for any length of 10
G 2	<p>a)</p>  <p>b)</p> 	<p>B – CARRIAGE</p> <p>Checking of straightness of carriage movement in a horizontal plane or, possibly, in a plane defined by the axis of the centres and the tool point.</p>	$DC \leq 500$ 0,01	$DC \leq 20$ 0.0004
			$500 < DC \leq 1000$ 0,015	$20 < DC \leq 40$ 0.0006
			$1000 < DC \leq 1500$ 0,02	$40 < DC \leq 60$ 0.0008

* DC = distance between centres.

D_a = maximum permissible diameter above the bed.

** See clause 5, page 13.

Permissible deviation*				Measuring instruments	Observations and references to the test code ISO/R 230
Other lathes					
mm		in			
$Da \leq 800$	$800 < Da \leq 1600$	$Da \leq 32$	$32 < Da \leq 64$		
$DC \leq 500$ 0,01 (convex) 0,015 (convex)		$DC \leq 20$ 0.0004 (convex) 0.0006 (convex)		Precision levels, optical or other methods	a) Clauses 3.11, 3.21, 5.212.21 and 5.212.22 Make the measurements at a number of positions equally spaced along the length of the bed. The levels may be placed on the transverse slide. When the slideways are not horizontal, use a special straightedge as mentioned in figure 12 of clause 5.212.21 (2°).
$500 < DC \leq 1000$ 0,02 (convex) 0,03 (convex) Local tolerance** : 0,0075 0,01 for any length of 250		$20 < DC \leq 40$ 0.0008 (convex) 0.0012 (convex) Local tolerance** : 0.0003 0.0004 for any length of 10			
$DC > 1000$ For each 1000 increase in distance between centres beyond 1000, add to the corresponding preceding tolerance : 0,01 0,02 Local tolerance** : 0,015 0,02 for any length of 500		$DC > 40$ For each 40 increase in distance between centres beyond 40, add to the corresponding preceding tolerance : 0.0004 0.0008 Local tolerance** : 0.0006 0.0008 for any length of 20			
b) Variation of level : 0,04/1000		b) Variation of level : 0.0016/40		Precision levels	b) Clause 5.412.7 Place a level transversely on the slideways and take measurements at a number of positions equally spaced along the length of the slideways. The variation of level measured at any position shall not exceed the permissible deviation.
$DC \leq 500$ 0,015 0,02		$DC \leq 20$ 0.0006 0.0008		a) For $DC < 1500$ mm (< 60 in), dial gauge and mandrel between centres or straight-edge b) Whatever the value of DC , taut wire and microscope or optical methods	a) Clause 5.232.3 a) or 5.232.1 Touch the front generatrix of the mandrel (instead of the mandrel, a straightedge with parallel faces may be used). Length of mandrel between centres shall be as nearly as possible equal to the value of DC . b) Clauses 5.212.3 and 5.232.3 b) The deviation of straightness of carriage movement shall, other than in exceptional cases, be concave relative to the axis of the centres.
$500 < DC \leq 1000$ 0,02 0,025		$20 < DC \leq 40$ 0.0008 0.0010			
$DC > 1000$ For each 1000 increase in distance between centres beyond 1000, add to the corresponding preceding tolerance : 0,005 Maximum permissible deviation : 0,03 0,05		$DC > 40$ For each 40 increase in distance between centres beyond 40, add to the corresponding preceding tolerance : 0.0002 Maximum permissible deviation : 0.0012 0.0020			

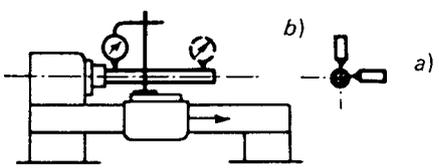
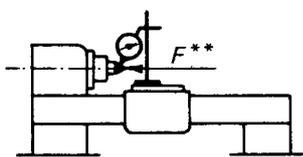
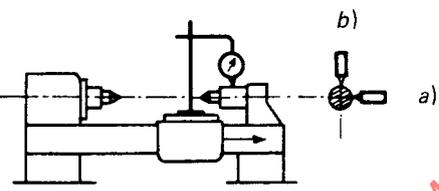
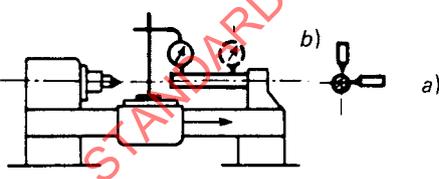
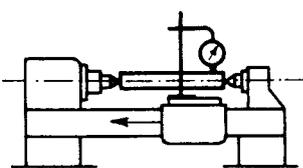
No.	Diagram	Object	Precision lathes	
			mm	in
			$Da \leq 500$ and $DC \leq 1500$	$Da \leq 20$ and $DC \leq 60$
G 3		<p>Checking of parallelism of tailstock to carriage movements :</p> <p>a) in the horizontal plane;</p> <p>b) in the vertical plane.</p>	<p>a) 0,02</p> <p>Local tolerance : 0,01 for any length of 500</p> <p>b) 0,03</p> <p>Local tolerance : 0,02 for any length of 500</p>	<p>a) 0.0008</p> <p>Local tolerance : 0.0004 for any length of 20</p> <p>b) 0.0012</p> <p>Local tolerance : 0.0008 for any length of 20</p>
G 4		<p>C – HEADSTOCK SPINDLE</p> <p>a) Measurement of periodic axial slip;</p> <p>b) Measurement of camming of the face plate resting surface.</p>	<p>a) 0,005</p> <p>b) 0,01 including periodic axial slip</p>	<p>a) 0.0002</p> <p>b) 0.0004 including periodic axial slip</p>
G 5		<p>Measurement of run-out of spindle nose centring sleeve</p>	<p>0,007</p>	<p>0.0003</p>
G 6		<p>Measurement of run-out of axis of centre :</p> <p>a) at the spindle nose of the housing;</p> <p>b) at a distance from the spindle nose equal to $\frac{Da}{2}$ or not more than 300 mm (12 in)¹⁾.</p>	<p>a) 0,005</p> <p>b) 0,015 for a measuring length of 300</p> <p>0,01 for a measuring length of 200</p> <p>0,005 for a measuring length of 100</p>	<p>a) 0.0002</p> <p>b) 0.0006 for a measuring length of 12</p> <p>0.0004 for a measuring length of 8</p> <p>0.0002 for a measuring length of 4</p>

* DC = distance between centres.

Da = maximum permissible diameter above the bed.

** F = constant pressure on spindle to eliminate axial bearing end play.

Permissible deviation*				Measuring instruments	Observations and references to the test code ISO/R 230
Other lathes					
mm		in			
$Da \leq 800$	$800 < Da \leq 1600$	$Da \leq 32$	$32 < Da \leq 64$		
$DC \leq 1500$ a) and b) 0,03 a) and b) 0,04 Local tolerance : 0,02 for any length of 500 $DC > 1500$ a) and b) 0,04 Local tolerance : 0,03 for any length of 500		$DC \leq 60$ a) and b) 0.0012 a) and b) 0.0016 Local tolerance : 0.0008 for any length of 20 $DC > 60$ a) and b) 0.0016 Local tolerance : 0.0012 for any length of 20		Dial gauge	Clause 5.422.5 With the tailstock as close as possible to the carriage take the readings when both are moved together; keep the tailstock sleeve locked so that the dial gauge fixed on the carriage always touches the same point.
a) 0,01 b) 0,02 including periodic axial slip	a) 0,015 b) 0,02	a) 0.0004 b) 0.0004 including periodic axial slip	a) 0.0006 b) 0.0008	Dial gauge and, possibly, a special device	Clauses 5.62, 5.621.2, 5.622.2 and 5.632 For the position of the dial gauge, see figures 59 to 64 and 67 of clauses 5.62, 5.622 and 5.632. The value of force F to be applied for the tests a) and b) shall be specified by the manufacturer.
0,01	0,015	0.0004	0.0006	Dial gauge	Clauses 5.612.2 and 5.621.2 The value of force F to be applied shall be specified by the manufacturer. In the case of a tapered spindle nose, fix the dial gauge perpendicular to the generating line of the taper.
a) 0,01 b) 0,02 for a measuring length of 300	a) 0,015 b) 0,05 for a measuring length of 500	a) 0.0004 b) 0.0008 for a measuring length of 12	a) 0.0006 b) 0.0020 for a measuring length of 20	Dial gauge and test mandrel	Clause 5.612.3 1) For lathes such that $Da > 800$ mm (32 in), the measuring length might be increased up to 500 mm (20 in).

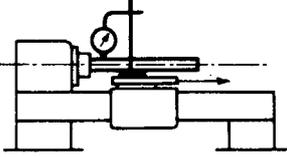
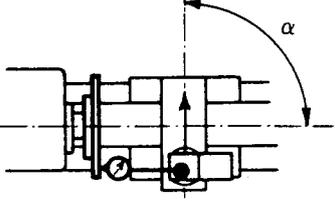
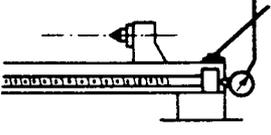
No.	Diagram	Object	Precision lathes	
			mm	in
			$Da \leq 500$ and $DC \leq 1500$	
			$Da \leq 20$ and $DC \leq 60$	
G 7		Checking of parallelism of spindle axis to carriage longitudinal movement on a length equal to $\frac{Da}{2}$ or a maximum equal to 300 mm (12 in) ¹⁾ : a) in the horizontal plane; b) in the vertical plane.	a) 0,01/300 frontwards b) 0,02/300 upwards	a) 0.0004/12 frontwards b) 0.0008/12 upwards
G 8		Measurement of run-out of centre.	0,01	0.0004
G 9		D – TAILSTOCK Checking of parallelism of the axis of the outside of tailstock sleeve to carriage movement: a) in the horizontal plane; b) in the vertical plane.	a) 0,01/100 frontwards b) 0,015/100 upwards	a) 0.0004/4 frontwards b) 0.0006/4 upwards
G 10		Checking of parallelism of taper bore of sleeve to carriage movement on a length equal to $\frac{Da}{4}$ or a maximum equal to 300 mm (12 in) ¹⁾ : a) in the horizontal plane; b) in the vertical plane.	a) 0,02/300 frontwards b) 0,02/300 upwards	a) 0.0008/12 frontwards b) 0.0008/12 upwards
G 11		E – CENTRES Checking of difference in height between headstock and tailstock centres.	0,02 Tailstock centre higher than headstock centre	0.0008 Tailstock centre higher than headstock centre

* DC = distance between centres.

Da = maximum permissible diameter above the bed.

** F = constant pressure on spindle to eliminate axial bearing end play.

Permissible deviation*				Measuring instruments	Observations and references to the test code ISO/R 230
Other lathes					
mm		in			
$D_a \leq 800$	$800 < D_a \leq 1600$	$D_a \leq 32$	$32 < D_a \leq 64$		
a) 0,015/300 frontwards b) 0,02/300 upwards	a) 0,03/500 frontwards b) 0,04/500 upwards	a) 0.0006/12 frontwards b) 0.0008/12 upwards	a) 0.0012/20 frontwards b) 0.0016/20 upwards	Dial gauge and test mandrel	Clauses 5.412.1 and 5.422.3 1) For lathes such that $D_a > 800$ mm (32 in), the measuring length might be increased up to 500 mm (20 in).
0,015	0,02	0.0006	0.0008	Dial gauge	Clauses 5.612.2 and 5.621.2 The dial gauge being placed perpendicularly to the taper surface of the head centre, and tolerance being given in a plane perpendicular to the spindle axis, divide the readings observed by $\cos \alpha$, α being the semi cone angle of the taper. The value of force F to be applied shall be specified by the manufacturer.
a) 0,015/100 frontwards b) 0,02/100 upwards	a) 0,02/100 frontwards b) 0,03/100 upwards	a) 0.0006/4 frontwards b) 0.0008/4 upwards	a) 0.0008/4 frontwards b) 0.0012/4 upwards	Dial gauge	Clause 5.422.3 After the tailstock sleeve has been sufficiently extended, it shall be locked as under normal working conditions.
a) 0,03/300 frontwards b) 0,03/300 upwards	a) 0,05/500 frontwards b) 0,05/500 upwards	a) 0.0012/12 frontwards b) 0.0008/12 upwards	a) 0.0020/20 frontwards b) 0.0020/20 upwards	Dial gauge and test mandrel	Clause 5.422.3 Lock the tailstock sleeve as under normal working conditions. 1) For lathes such that $D_a > 800$ mm (32 in), the measuring length might be increased up to 500 mm (20 in).
0,04 Tailstock centre higher than headstock centre	0,06	0.0016 Tailstock centre higher than headstock centre	0.0024	Dial gauge and test mandrel	Clause 5.422.3 Touch the top generatrix of the mandrel. Take readings at the extremities of the test mandrel with the tailstock and tailstock sleeve locked, as under normal working conditions.

No.	Diagram	Object	Precision lathes	
			mm	in
			$Da \leq 500$ and $DC \leq 1500$	$Da \leq 20$ and $DC \leq 60$
G 12		F – UPPER SLIDE Checking of parallelism of the longitudinal movement of the upper slide to the spindle axis.	0,015/150	0.0006/6
G 13		G – CROSS SLIDE Checking of squareness of the transverse movement of the cross slide to the spindle axis.	0,01/300 Direction of deviation : $\alpha \geq 90^\circ$	0.0004/12 Direction of deviation : $\alpha \geq 90^\circ$
G 14		H – LEAD SCREW Measurement of periodic axial slip due to camming of each thrust bearing.	0,01	0.0004
G 15		Measurement of the accuracy of the pitch generated by the lead screw.	a) 0,03 For any measured length of 300 b) 0,01 For any measured length of 60	a) 0.0012 for any measured length of 12 b) 0.0004 for any measured length of 2.4

* DC = distance between centres.

Da = maximum permissible diameter above the bed.

Permissible deviation*				Measuring instruments	Observations and references to the test code ISO/R 230
Other lathes					
mm		in			
$Da \leq 800$	$800 < Da \leq 1600$	$Da \leq 32$	$32 < Da \leq 64$		
0,04/300		0.0016/12		Dial gauge and test mandrel	Clause 5.422.3 Make the measurement in the vertical plane (after setting up the upper slide parallel with the spindle axis in the horizontal plane), only in the working position of the upper slide.
0,02/300 Direction of deviation : $\alpha \geq 90^\circ$		0.0008/12 Direction of deviation : $\alpha \geq 90^\circ$		Dial gauge and flat disk or straight-edge	Clauses 5.522.3 and 3.22
0,015	0,02	0.0006	0.0008	Dial gauge	Clauses 5.622.1 and 5.622.2 This operation may be deleted if practical test P3 is carried out.
$DC \leq 2000$ a) 0,04 For any measured length of 300 $DC > 2000$ For each 1000 increase in distance between centres beyond 2000, add to the corresponding preceding tolerance : 0,005 Maximum permissible deviation : 0,05 b) 0,015 for any measured length of 60		$DC \leq 80$ a) 0.0016 for any measured length of 12 $DC > 80$ For each 40 increase in distance between centres beyond 80, add to the corresponding preceding tolerance : 0.0002 Maximum permissible deviation : 0.0020 b) 0.0006 for any measured length of 2.4			Clauses 6.1 and 6.2 <i>Precision lathes.</i> A record of the pitch accuracy will be made by means of an electric pick-up, for instance, feeling the flanks of the threads of a master lead screw of 300 mm (12 in) length held between centres. <i>Other lathes.</i> Length bars will be used associated with a dial gauge so as to compare the carriage travel to the number of corresponding revolutions of the spindle. However, for both classes of lathes, a record of the lead screw accuracy (over a specified length and checked along four generators shifted 90° forward) should be satisfactory.