

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1701

TEST CONDITIONS FOR MILLING MACHINES
WITH TABLE OF VARIABLE HEIGHT,
WITH HORIZONTAL OR VERTICAL SPINDLE
TESTING OF THE ACCURACY

1st EDITION

April 1970

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BRIEF HISTORY

The ISO Recommendation R 1701, *Test conditions for milling machines with table of variable height, with horizontal or vertical spindle – Testing of the accuracy*, was drawn up by Technical Committee ISO/TC 39, *Machine tools*, the Secretariat of which is held by the Association Française de Normalisation (AFNOR).

Work on this question led to the adoption of Draft ISO Recommendation No. 1701 which was circulated to all the ISO Member Bodies for enquiry in August 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	India	Spain
Belgium	Iran	Sweden
Brazil	Israel	Switzerland
Czechoslovakia	Italy	Thailand
Finland	Korea, Rep. of	Turkey
France	Netherlands	U.A.R.
Germany	New Zealand	United Kingdom
Greece	Romania	
Hungary	South Africa, Rep. of	

The following Member Body opposed the approval of the Draft :

Japan

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in April 1970, to accept it as an ISO RECOMMENDATION.

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TEST CONDITIONS FOR MILLING MACHINES
WITH TABLE OF VARIABLE HEIGHT,
WITH HORIZONTAL OR VERTICAL SPINDLE
TESTING OF THE ACCURACY

1. SCOPE

This ISO Recommendation describes, with reference to ISO Recommendation R 230, *Machine tool test code*, both geometrical and practical tests on milling machines with table of variable height and with horizontal or vertical spindle, and gives the permissible deviations corresponding to general purpose and normal accuracy machines.

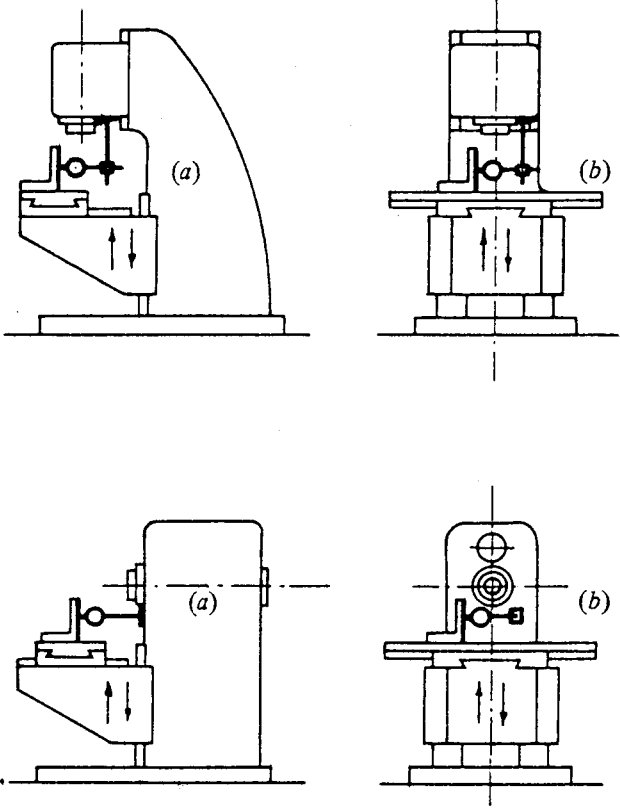
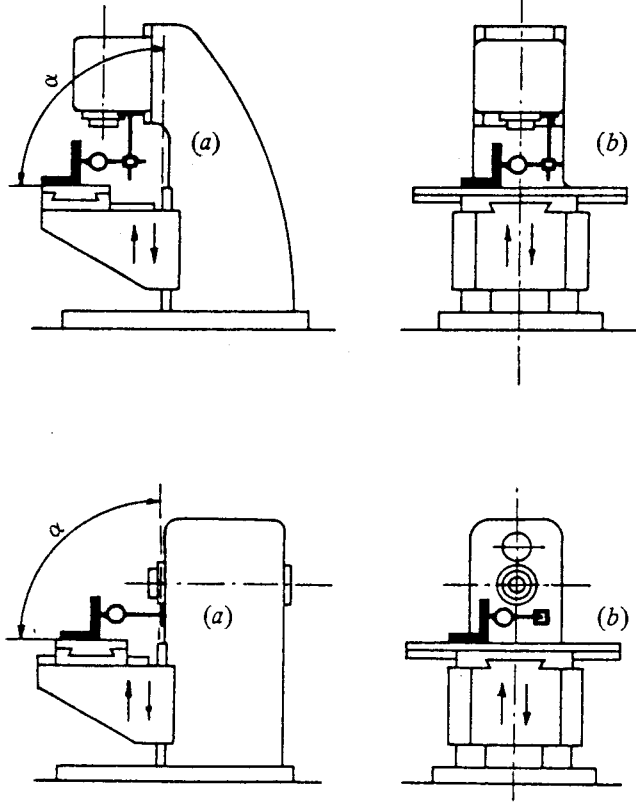
It deals only with the verification of accuracy of the machine and does not apply to the testing of the running (vibrations, abnormal noises, stick-slip motion of components, etc.), or to characteristics (speeds, feeds, etc.) which should generally be checked before testing accuracy.

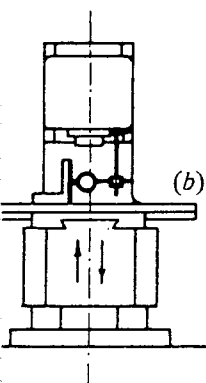
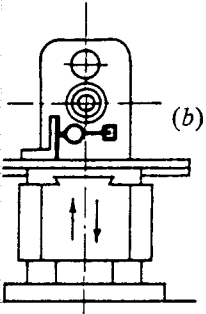
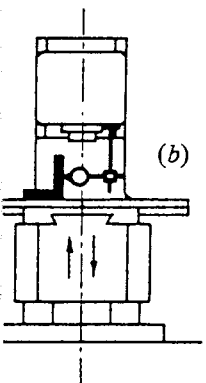
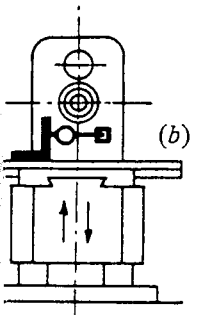
2. PRELIMINARY REMARKS

- 2.1 In this ISO Recommendation, all the dimensions are expressed in millimetres in section 3 and in inches in section 4.
- 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 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 instance : 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 establishing the tolerance 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 0.01 mm (0.0004 in).

3. TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

3.1 Geometrical tests

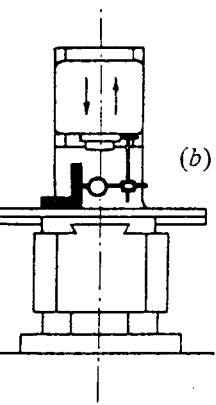
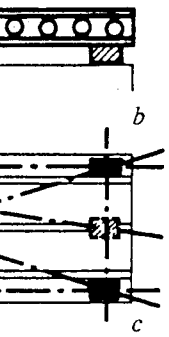
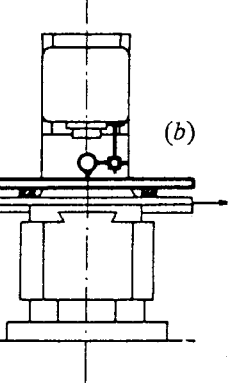
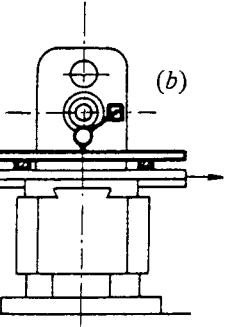
No.	Diagram	Object
G 1		Checking of straightness of the vertical movement of the knee : (a) in the vertical plane of symmetry of the machine or transverse vertical plane; (b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.
G 2		Checking of squareness of the table surface to the column ways for knee (in three positions : in the middle and near the extremities of the travel) : (a) in the vertical plane of symmetry of the machine or transverse vertical plane; (b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.

	Object	Permissible deviation	Measuring instrument:
 	Checking of straightness of the vertical movement of the knee : (a) in the vertical plane of symmetry of the machine or transverse vertical plane; (b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.	(a) 0.025 for a measuring length of 300 (b) 0.025 for a measuring length of 300	Dial gauge and square
 	Checking of squareness of the table surface to the column ways for knee (in three positions : in the middle and near the extremities of the travel) : (a) in the vertical plane of symmetry of the machine or transverse vertical plane; (b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.	(a) 0.025/300 with $\alpha \leq 90^\circ$ (b) 0.025/300	Dial gauge and square

Dimensions in millimetres

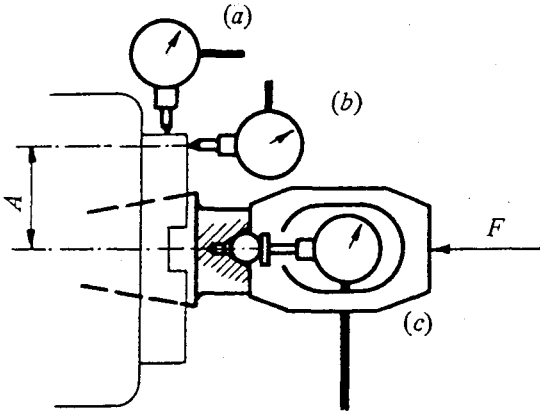
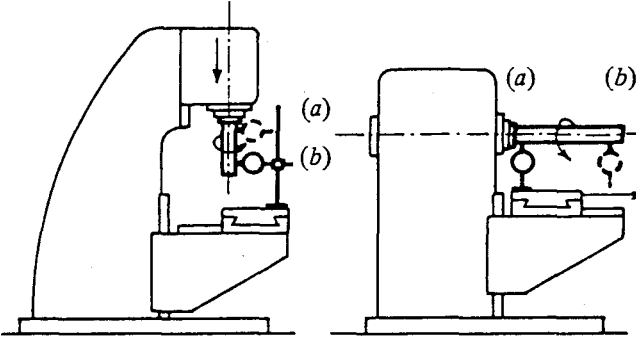
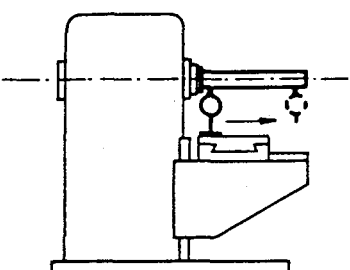
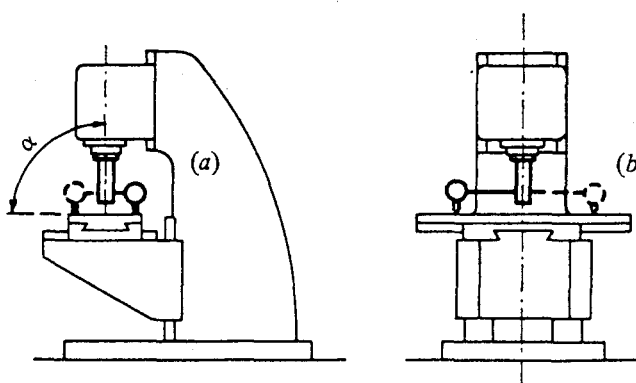
	Permissible deviation	Measuring instruments	Observations and references to the test code ISO/R 230
vertical move- symmetry of the tical plane; ar to the vertical the machine or	(a) 0.025 for a measuring length of 300 (b) 0.025 for a measuring length of 300	Dial gauge and square	Clause 5.232.1 Instead of a straightedge, use the vertical arm of a square. Table in central position, table and cross slide locked, knee not locked. 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.
table surface to three positions : extremities of the ymmetry of the tical plane; ar to the vertical the machine or	(a) 0.025/300 with $\alpha \leq 90^\circ$ (b) 0.025/300	Dial gauge and square	Clause 5.522.2 Table in central position, table and cross slide locked. Knee 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 should be placed on a fixed part of the machine.

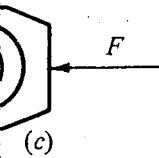
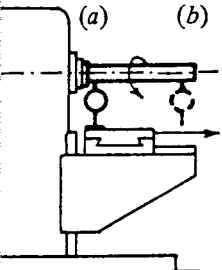
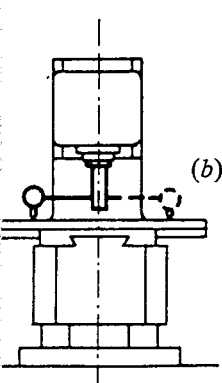
No.	Diagram	Object
G 3		Checking of squareness of the table surface to the vertical movement of the spindle head slide : (a) in the vertical plane of symmetry of the machine or transverse vertical plane; (b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.
G 4		Checking of flatness of the table surface.
G 5		Checking of parallelism of the table surface to its movement : (a) transversely; (b) longitudinally.

	Object	Permissible deviation	Measuring instrument
 (b)	Checking 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 or transverse vertical plane; (b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.	(a) 0.025/300 with $\alpha \leq 90^\circ$ (b) 0.025/300	Dial gauge and square
 b c	Checking of flatness of the table surface.	0.04 up to 1 000 For each 1 000 increase in table length, add 0.005 Maximum permissible deviation : 0.05 Local tolerance : 0.02 for any 300 length	Precision level or straight edge and slip gauges
 (b)  (b)	Checking of parallelism of the table surface to its movement : (a) transversely; (b) longitudinally.	(a) 0.025 for any 300 length (b) 0.025 for any 300 length Maximum permissible deviation : 0.05	Straightedge and dial gauge

Dimensions in millimetres

	Permissible deviation	Measuring instruments	Observations and references to the test code ISO/R 230
the table surface to spindle head slide : symmetry of the vertical plane; parallel to the vertical plane of the machine or	(a) 0.025/300 with $\alpha \leq 90^\circ$ (b) 0.025/300	Dial gauge and square	Clause 5.522.2 Table in central position, knee 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 should be placed on the spindle head slide of the machine.
the table surface.	0.04 up to 1 000 For each 1 000 increase in table length, add 0.005 Maximum permissible deviation : 0.05 Local tolerance : 0.02 for any 300 length	Precision level or straight-edge and slip gauges	Clauses 5.322 and 5.323 Table and cross slide in central position, table not locked, knee and cross slide locked. NOTE. – The alphabetical references on the diagram correspond to those used in Figure 19 of ISO Recommendation R 230.
the table surface to	(a) 0.025 for any 300 length (b) 0.025 for any 300 length Maximum permissible deviation : 0.05	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 straight-edge laid parallel to the table surface. If the table length is greater than 1600 mm, carry out the inspection by successive movements of the straightedge. Knee locked. 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. (a) Table and spindle head slide locked; (b) Cross slide and spindle head slide locked.

No.	Diagram	Object
G 6		(a) Measurement of run-out of the external centring surface on the spindle nose (for machines having this feature). (b) Measurement of camming of the face of the spindle nose (including periodic axial slip). (c) Measurement of periodic axial slip.
G 7		Measurement of run-out of the internal taper of the spindle : (a) at the mouth of taper; (b) at a distance of 300 from the spindle nose.
G 8		Checking of parallelism of the spindle axis to the table surface.
G 9		Checking of squareness of the spindle axis to the table surface : (a) in the vertical plane of symmetry of the machine or transverse vertical plane; (b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.

	Object	Permissible deviation	Measuring instrument:
 (c)	(a) Measurement of run-out of the external centring surface on the spindle nose (for machines having this feature). (b) Measurement of camming of the face of the spindle nose (including periodic axial slip). (c) Measurement of periodic axial slip.	(a) 0.01 (b) 0.02 (c) 0.01	Dial gauge
 (a) (b)	Measurement of run-out of the internal taper of the spindle : (a) at the mouth of taper; (b) at a distance of 300 from the spindle nose.	(a) 0.01 (b) 0.02	Dial gauge and test mand
	Checking of parallelism of the spindle axis to the table surface.	0.025 for a measuring length of 300 (free end of the test mandrel inclined downwards)	Dial gauge and test mand:
 (b)	Checking of squareness of the spindle axis to the table surface : (a) in the vertical plane of symmetry of the machine or transverse vertical plane; (b) in the plane perpendicular to the vertical plane of symmetry of the machine or transverse vertical plane.	(a) 0.025/300 with $\alpha \leq 90^\circ$ (b) 0.025/300	Dial gauge

Dimensions in millimetres

	Permissible deviation	Measuring instruments	Observations and references to the test code ISO/R 230
t of the external spindle nose (for ture). ng of the face of ling periodic axial c axial slip.	(a) 0.01 (b) 0.02 (c) 0.01	Dial gauge	(a) Clause 5.612.2 (b) Clause 5.632 The distance A of dial gauge (b) from the spindle axis should be as large as possible. (c) Clauses 5.662.1 and 5.622.2 A force F, specified by the manufacturer of the machine, should be exerted by pressing towards the housing for tests (b) and (c).
the internal taper from the spindle	(a) 0.01 (b) 0.02	Dial gauge and test mandrel	Clause 5.612.3
the spindle axis	0.025 for a measuring length of 300 (free end of the test mandrel inclined downwards)	Dial gauge and test mandrel	Clause 5.412.4. Table and cross slide not locked, knee locked.
spindle axis to the symmetry of the rtical plane; ar to the vertical the machine or	(a) 0.025/300 with $\alpha \leq 90^\circ$ (b) 0.025/300	Dial gauge	Clauses 5.512.1 and 5.512.42 Spindle head slide, table, cross slide and knee locked.