INTERNATIONAL STANDARD 3190

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Test conditions for turret and single spindle co-ordinate drilling machines with vertical spindle — Testing of the accuracy

Conditions d'essai des machines à percer verticales à coordonnées, du type monobroche ou à tourelle revolver — 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.

International Standard ISO 3190 was drawn up by Technical Committee ISO/TC 39, *Machine tools,* and circulated to the Member Bodies in November 1973.

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

Australia	Hungary	Sweden
Austria	India	Switzerland
Belgium	Italy	Thailand
Bulgaria	Japan	Turkey
Czechoslovakia	New Zealand	United Kingdom
Egypt, Arab Rep. of	Romania	U.S.A.
France	South Africa, Rep. of	U.S.S.R.
Germany	Spain	Yugoslavia

No Member Body expressed disapproval of the document.

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Test conditions for turret and single spindle co-ordinate drilling machines with vertical spindle — 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 and normal accuracy turret and single spindle co-ordinate drilling machines with vertical spindle and 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 machine characteristics (speeds, feeds, etc.) which should generally be checked before testing accuracy.

As there is great variety in the configuration of these machines, the most common being

- box type and variable height table machines,
- box type and fixed height table machines,
- bridge machines,

it is specified that the geometrical tests given in this International Standard shall be selected according to the particular conformation of the machine type considered.

2 REFERENCES

ISO/R 230, *Machine tool test code.*

ISO 3686, *Test conditions for turret and single spindle co-ordinate drilling and boring machines with table of fixed height with vertical spindle — Testing of the accuracy.* [1)]

3 PRELIMINARY REMARKS

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

To apply this International Standard, reference should 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.

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.

When inspecting a machine, it is not always possible, or 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 tests relating to the existing elements of the machine or to the properties which are of interest to him, but these tests are to be clearly stated when ordering a machine.

As far as turret head drilling machines are concerned it is intended that all geometrical tests which concern the rotation of the spindle, i.e. Tests G7, G8, G9 and G12, shall be carried out on all spindles.

When establishing the tolerance 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).

1) At present at the stage of draft.

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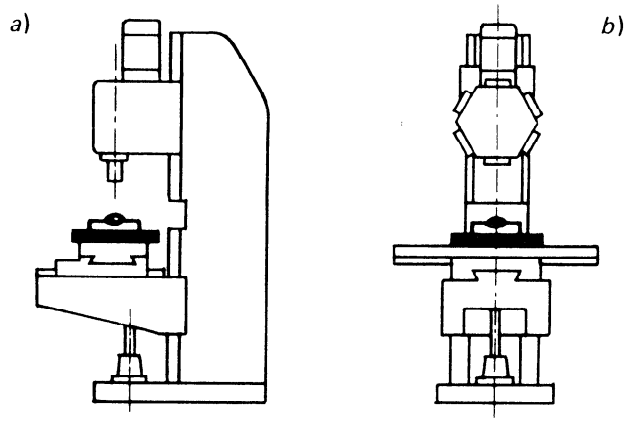
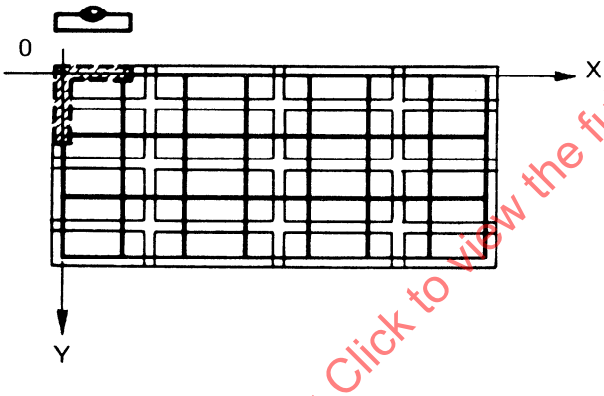
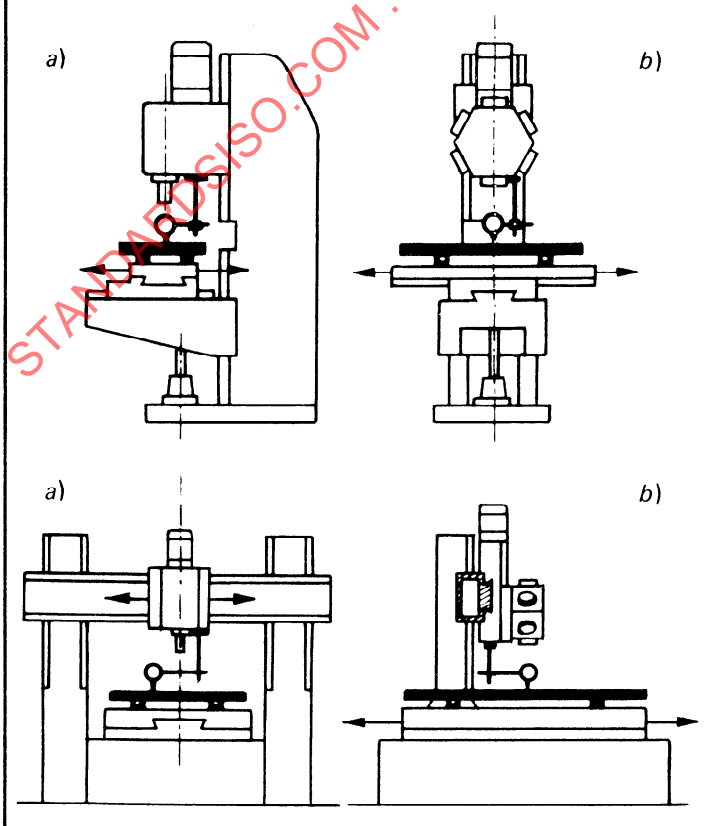
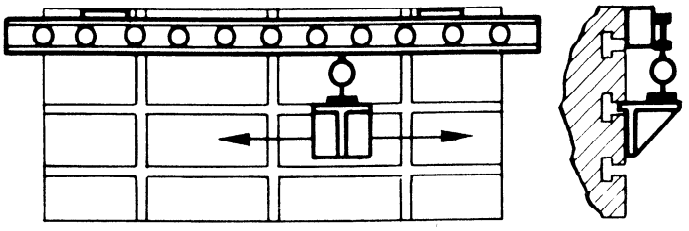
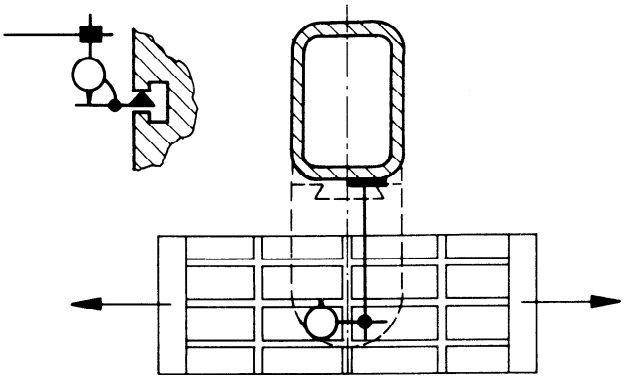
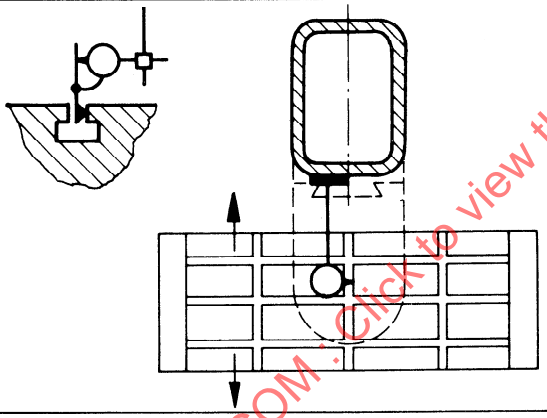
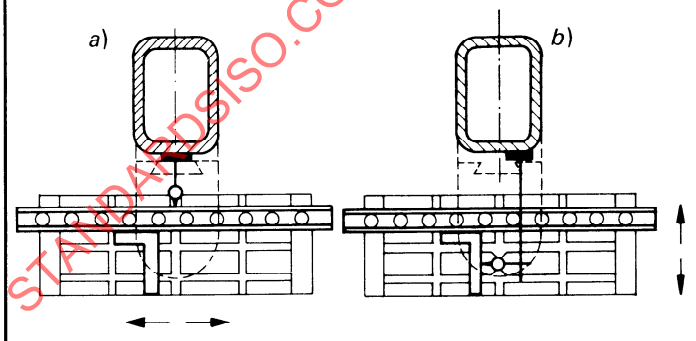
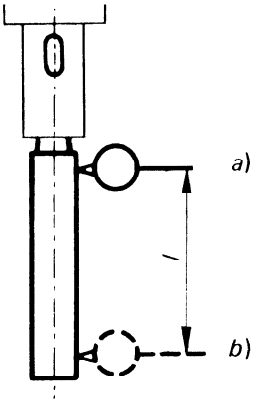
4 TEST CONDITIONS AND PERMISSIBLE DEVIATIONS

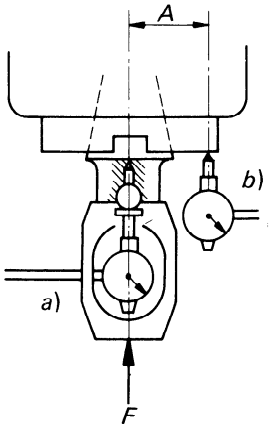
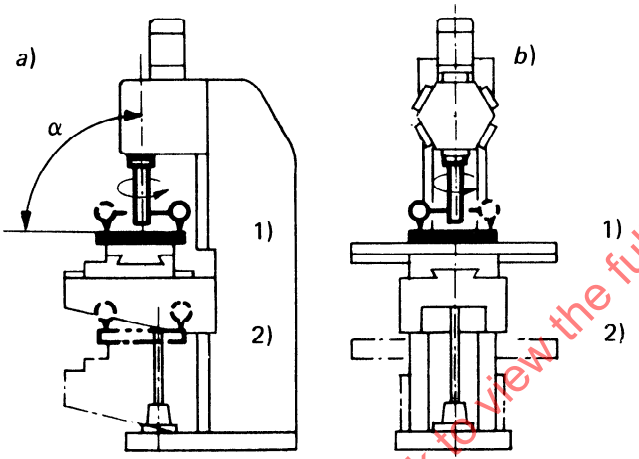
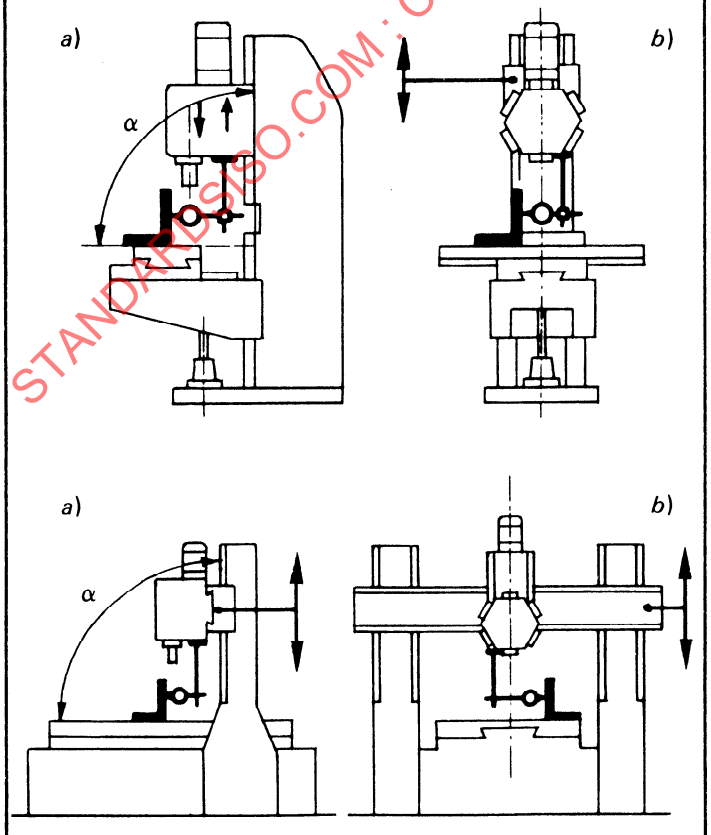
4.1 Geometrical tests

No.	Diagram	Object
G0		Levelling of the machine : *a*) in the plane of symmetry of the machine; *b*) in the plane perpendicular to the plane of symmetry of the machine and co-axial with the spindle axis.
G1		**A – TABLE** Checking of flatness of the table surface.
G2		Checking of parallelism of the table surface to : *a*) transverse movement of the table, or transverse movement of the spindle head; *b*) longitudinal movement of the table.

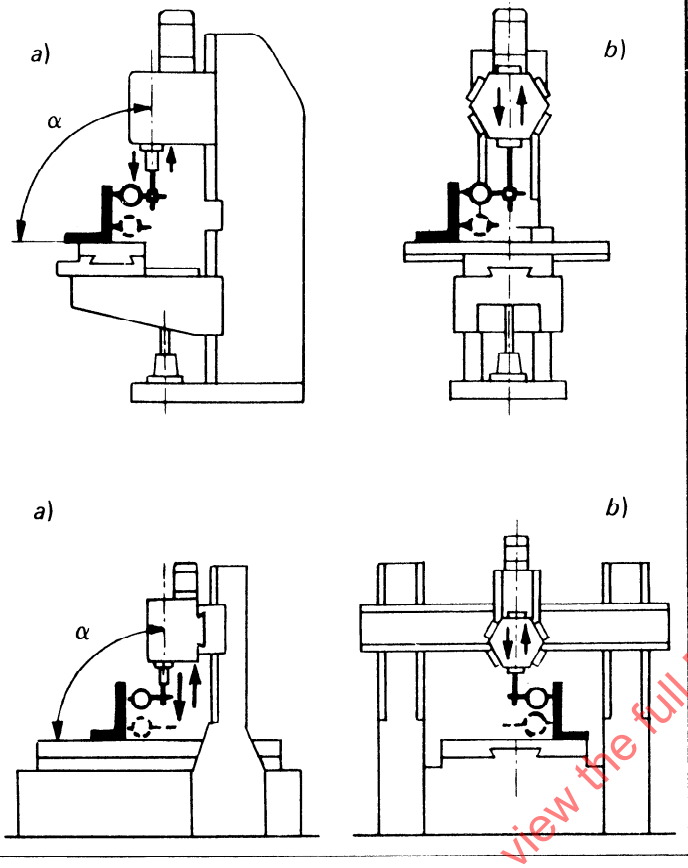
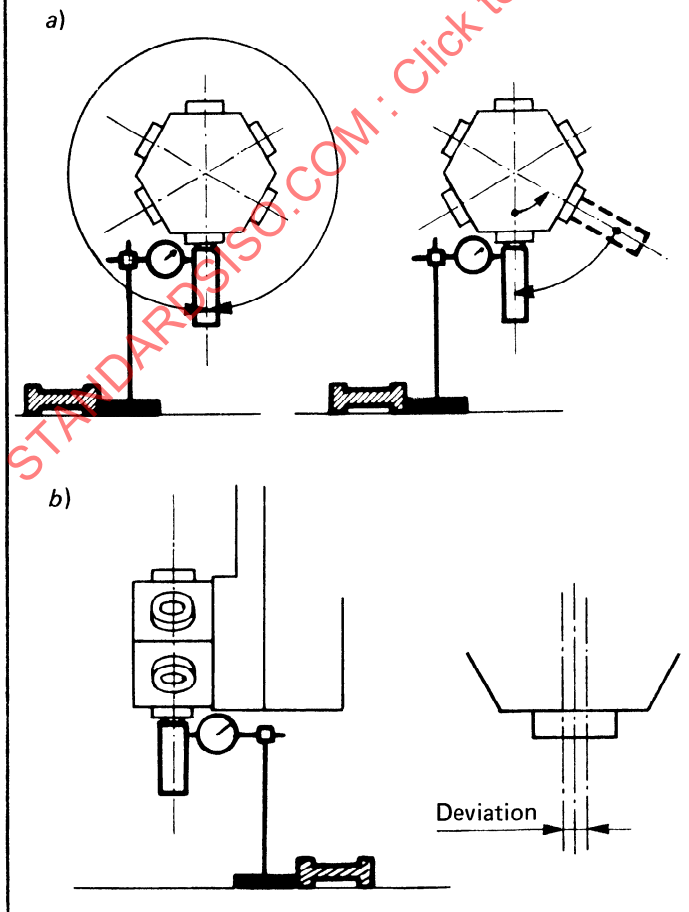
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,03/300	0.0012/12	Level and straightedge	Clauses 3.11 and 5.212.21
0,05 up to 1000 For each 1000 increase in length beyond : 1000 add to the preceding corresponding tolerance : 0,01 Maximum permissible deviation : 0,08	0.002 up to 40 40 40 0.0004 0.0032	Precision level or straightedges and gauge blocks	Clauses 5.322 and 5.323
0,025 for any measuring length of : 300 Maximum permissible deviation : 0,05	0.001 12 0.002	Straightedges and dial gauge	Clause 5.422.21 The stylus of the dial gauge shall be placed approximately at the spindle axis. The measurement may be made on a straightedge laid parallel to the table surface. If the table length is greater than 1 000 mm (40 in) the inspection may be carried out by successive movements of the straightedge. 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. Spindle head and knee or beam locked. *a*) Table locked; *b*) Cross slide locked.

	Diagram	Object
G3		Checking of straightness of the longitudinal median, or reference tee slot of the table.
G4		Checking of parallelism of the median or reference longitudinal tee slot of the table to its longitidinal movement.
G5		Checking of parallelism of the transverse median or reference tee slot of the table to the transverse table movement.
G6		Checking of squareness of the table longitudinal movement to its transverse movement or to the movement of the spindle head on the beam.
G7		**B – SPINDLE** Measurement of run-out of the internal taper of the spindle : *a)* near the spindle nose; *b)* at a distance *l* of 300 mm (12 in) from the spindle nose.

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,025 for any measuring length of : 500 Maximum permissible deviation : 0,03	0.001 20 0.0012	Straightedge, dial gauge or gauge blocks and block	Clauses 5.212, 5.212.1, 5.212.3 or 5.232 The straightedge may be placed directly on the table.
0,03 for any measuring length of : 500	0.0012 20	Dial gauge	Clause 5.422.21 Cross slide and knee locked.
0,025 for any measuring length of : 500	0.001 20	Dial gauge	Clause 5.422.21 Knee locked. Table locked in central position.
0,035/500	0.0014/20	Straightedge, dial gauge and square	Clause 5.522.4 Knee locked. *a*) The straightedge shall be set parallel to the longitudinal movement of the table; then the square shall be placed against the straightedge. Table locked in central position. *b*) Then check the table transverse movement or the spindle head movement on the beam.
ı) 0,01 ›) 0,02	*a*) 0.000 4 *b*) 0.000 8	Dial gauge and test mandrel	Clause 5.612.3 Checking shall be repeated on all spindles, in the case of turret head drilling machines.

No.	Diagram	Object	
G8		*a*) Measurement of periodic axial slip; *b*) Measurement of camming of the face of the spindle nose (including periodic axial slip).	*a*) *b*)
G9		Checking of squareness of the spindle axis to the table surface and of straightness of the vertical slideways of the table : *a*) in the vertical plane of symmetry of the machine; *b*) in the plane perpendicular to the vertical plane of symmetry of the machine.	*a*) *b*) *a*) *b*)
G10		**C – SPINDLE HEAD** Checking of squareness of the table surface to the vertical movement of the spindle head or the beam on the columns : *a*) in the vertical plane of symmetry of the machine; *b*) in the plane perpendicular to the vertical plane of symmetry of the machine.	*a*) *b*)

Permissible deviation			Measuring instruments	Observations and references to the test code ISO/R 230
mm		in		
0,01 0,02	*a*) *b*)	0.0004 0.0008	Dial gauge	*a*) Clauses 5.622.1 and 5.622.2 A force *F*, specified by the manufacturer of the machine, should be exerted by pressing towards the housing for tests *a*) and *b*). *b*) Clause 5.632 The distance *A* of dial gauge b) from the spindle axis should be as large as possible. Checking should be repeated on all spindles, in the case of turret head drilling machines.
A – SINGLE SPINDLE MACHINE 0,02/300* with $\alpha \leqslant 90^\circ$ 0,02/300 B – TURRET MACHINE 0,025/300* with $\alpha \leqslant 90^\circ$ 0,025/300*	 *a*) *b*) *a*) *b*)	 0.0008/12* with $\alpha \leqslant 90^\circ$ 0.0008/12 0.001/12* with $\alpha \leqslant 90^\circ$ 0.001/12	Dial gauge, straightedge and test mandrel	Clauses 5.512.1 and 5.512.42 For machines having a table of variable height, the inspection shall be carried out first with the table in the upper position 1) and then in the lower position 2). Spindle head, table, cross slide, knee or beam locked. Checking shall be repeated on all spindles, in the case of turret head drilling machines. * Distance between the two points touched.
0,025/300 with $\alpha \leqslant 90^\circ$ 0,025/300	*a*) *b*)	0.001/12 with $\alpha \leqslant 90^\circ$ 0.001/12	Dial gauge and square	Clause 5.522.2 Table locked in central position. Cross slide and knee locked. Spindle head or beam locked when taking measurements.

No.	Diagram	Object	
G11		Checking of squareness of the table surface to the vertical movement of the spindle housing or quill or the turret head on its slideways : *a*) in the vertical plane of symmetry of the machine; *b*) in the plane perpendicular to the vertical plane of symmetry of the machine.	*a*) *b*)
G12		**D – MULTI-SPINDLE TURRET HEAD** Measurement of the accuracy of the positioning of the axes of the internal mounting surface of the spindles and checking of the repeatability of these positionings *a*) in a vertical plane perpendicular with a vertical plane passing through the axis of rotation of the turret; *b*) in a vertical plane passing through the axis of rotation of the turret.	

Permissible deviation			Measuring instruments	Observations and references to the test code ISO/R 230
mm		in		
0,025/300 with $\alpha \leqslant 90^\circ$ 0,025/300	*a*) *b*)	0.001/12 with $\alpha \leqslant 90^\circ$ 0.001/12	Dial gauge and square	Clause 5.522.2 Table locked in central position. Spindle head, cross slide and knee locked.
0,025		0.001	Straightedge, dial gauges, and test mandrel	Clauses 5.412.1 and 6.4 For *a*) and *b*) the dial gauge support shall be set against the straightedge to place the stylus on the centre line of the test mandrel and as near as possible to the spindle nose. The dial gauge shall be adjusted to give zero reading on the test mandrel in reference spindle at mean runout position. The turret shall be rotated one complete revolution. If it is not possible to rotate one complete revolution, the turret shall be revolved through the largest possible fraction of a revolution first in one direction, then in the opposite direction, so as to bring it back to its original position. The turret shall then be indexed and locked and the deviation observed. The turret shall then be indexed to the next position and the test mandrel transferred from the reference spindle. Similarly but without the dial gauge being re-zeroed, the spindle shall be rotated to the mean runout and the deviation observed before and after one complete (or partial) revolution of the turret. Repeat for all spindles. All slides locked except drilling feed slide.