International Standard 3070/3

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

Acceptance conditions for boring and milling machines — Testing of the accuracy — Part 3 : Planer type machines with movable column

Conditions de réception des machines à aléser et à fraiser, à broche horizontale — Contrôle de la précision — Partie 3 : Machines à montant mobile et bancs en croix

First edition — 1982-01-15

UDC 621.914.4-187 **Ref. No. ISO 3070/3-1982 (E)**

Descriptors : boring and milling machines, tests, test conditions, dimensional measurement, accuracy.

Price based on 26 pages

Foreword

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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 3070/3 was developed by Technical Committee ISO/TC 39, *Machine tools*, and was circulated to the member bodies in August 1980.

It has been approved by the member bodies of the following countries :

Australia	India	South Africa, Rep. of
Belgium	Italy	Spain
Bulgaria	Japan	Sweden
China	Korea, Dem. P. Rep. of	Switzerland
Czechoslovakia	Korea, Rep. of	United Kingdom
France	Mexico	USA
Germany, F.R.	Poland	USSR
Hungary	Romania	

No member body expressed disapproval of the document.

Printed in Switzerland

Acceptance conditions for boring and milling machines — Testing of the accuracy — Part 3 : Planer type machines with movable column

1 Scope and field of application

This part of ISO 3070 describes, with reference to ISO/R 230, both geometrical and practical tests on general purpose and normal accuracy boring and milling machines, planer type with movable column, and the corresponding permissible deviations which apply.

This part of ISO 3070 concerns machines which are defined in sub-clause 3.2 and 3.3 of ISO 3070/0.

These machines can be provided with spindle heads of different types corresponding in most cases to figures :

4 (spindle head with milling spindle and boring spindle),

5 (spindle head with sliding boring spindle and with facing head),

6 (spindle head with ram or milling arm),

of Part 0 : "General Introduction" of ISO 3070.

It must moreover be made clear that this part of ISO 3070 concerns machines which have a movement of the table along the X-axis and possibly, a movement of rotation along a vertical axis parallel to the Y-axis.

This part of ISO 3070 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 (such as speeds, feeds, etc.) which should generally be checked before testing accuracy.

2 Preliminary remarks

2.1 In this part of ISO 3070, deviations and ranges are expressed in millimetres and in inches.

2.2 To apply this part of ISO 3070, reference should be made to ISO/R 230, especially for installation of the machine before testing, warming up of spindles or 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 possible or necessary to carry out all the tests given in this part of ISO 3070. 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 establishing the tolerance for a measuring range different from that given in this part of ISO 3070 (see 2.311 in ISO/R 230) it should be taken into consideration that the minimum value of tolerance is 0,002 5 mm (0.000 1 in) for both geometrical and practical tests.

NOTES

1 For rotary table machines, reference should be made to the complementary tests indicated in addendum 1 to ISO 3070/1.

2 For machines which have a steady, reference should be made to the test G 30.

3 References

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

ISO 841, *Numerical control of machines — Axis and motion nomenclature.*

ISO 1101, *Technical drawings — Tolerances of form and of position — Part 1 : Generalities, symbols, indications on drawings.*[1)]

1) At present at the stage of draft. (Revision of ISO/R 1101/1-1969.)

ISO 3070/0, *Test conditions for boring and milling machines with horizontal spindle — Testing of the accuracy — Part 0 : General introduction.*

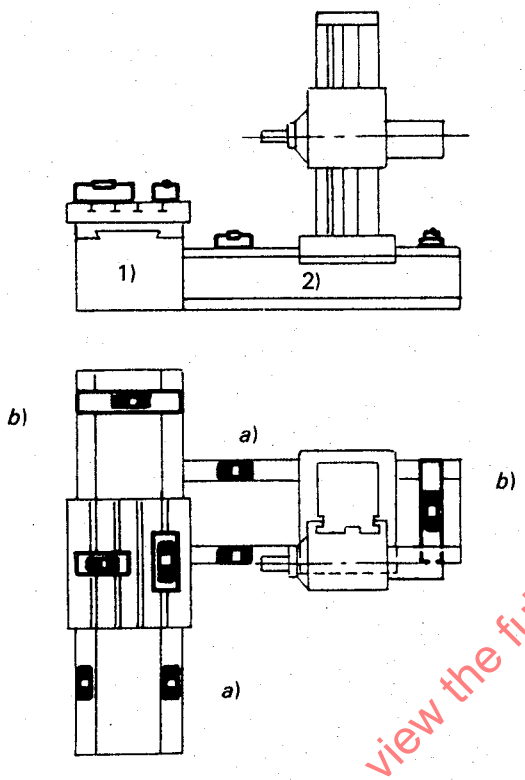
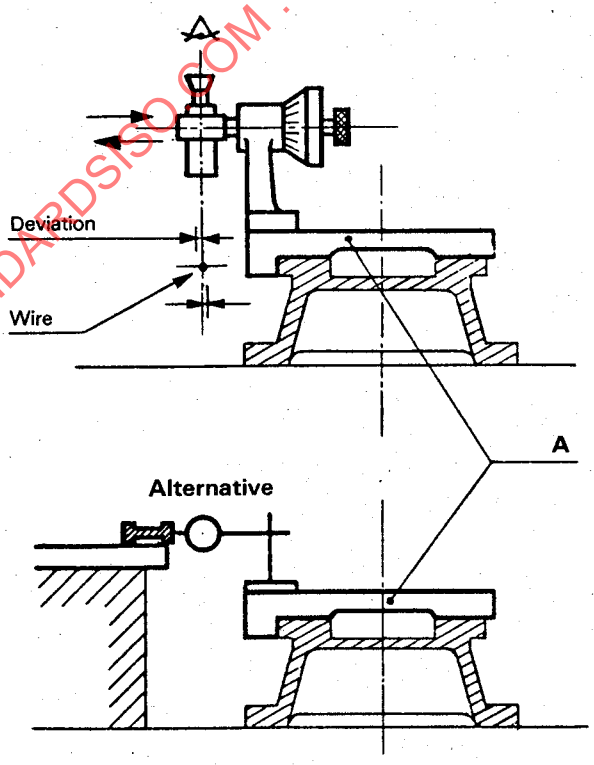
ISO 3070/1, *Test conditions for boring and milling machines with horizontal spindle — Testing of the accuracy — Part 1 : Table type machines.*

Addendum 1 to ISO 3070/1, *Complementary geometrical tests and practical test to be specified in the case of rotary table machines.*

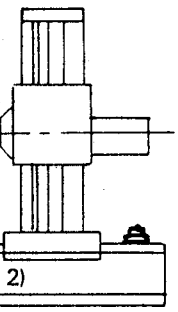
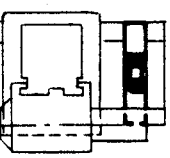
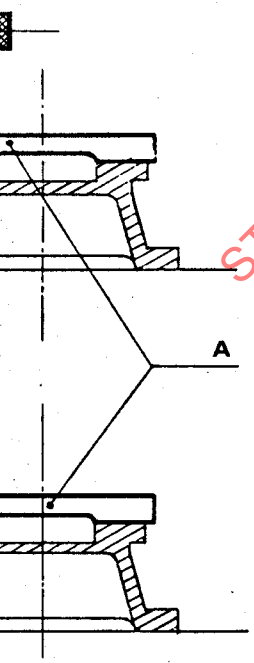
ISO 3070/2, *Test conditions for boring and milling machines with horizontal spindle — Testing of the accuracy — Part 2 : Floor type machines.*

4 Test conditions and permissible deviations

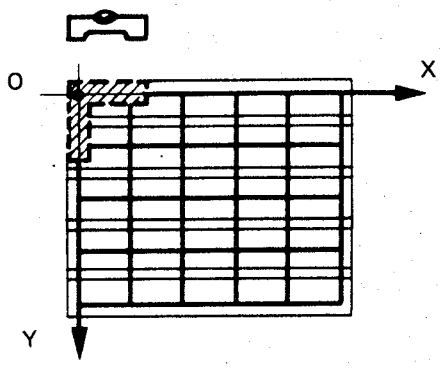
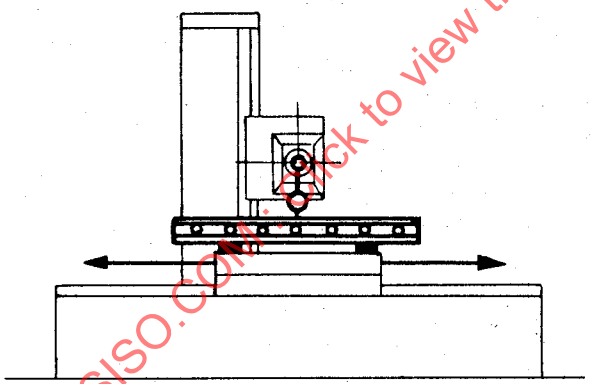
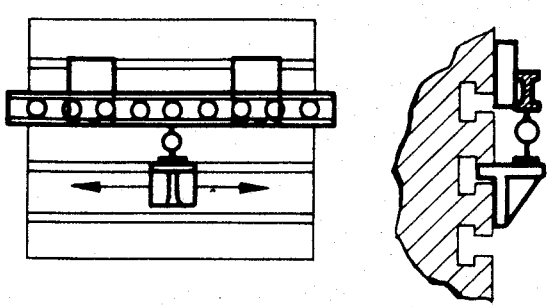
4.1 Geometrical tests

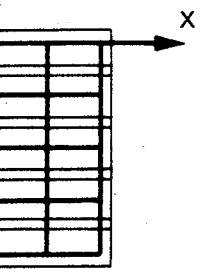
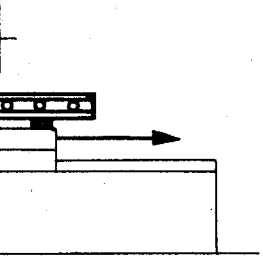
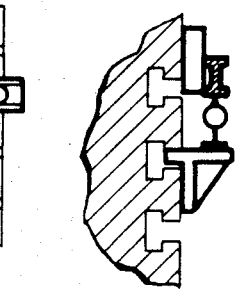
No.	Diagram	Object	
G 1		**A – TABLE AND COLUMN BEDS** Verification of levelling of slideways : *a)* Checking of bed lengthwise : – straightness of slideways in the vertical plane 1) table bed; 2) column bed.	*a)* For tole
		b) Checking of bed crosswise : – slideways should be in the same plane 1) table bed; 2) column bed.	*b)*
G 2		Checking of straightness of the slideways in a horizontal plane : 1) table bed; 2) column bed.	For tole

and h

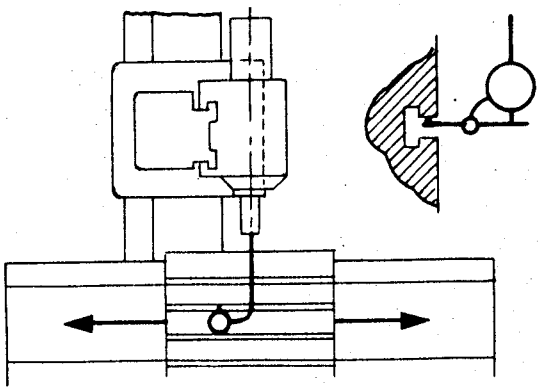
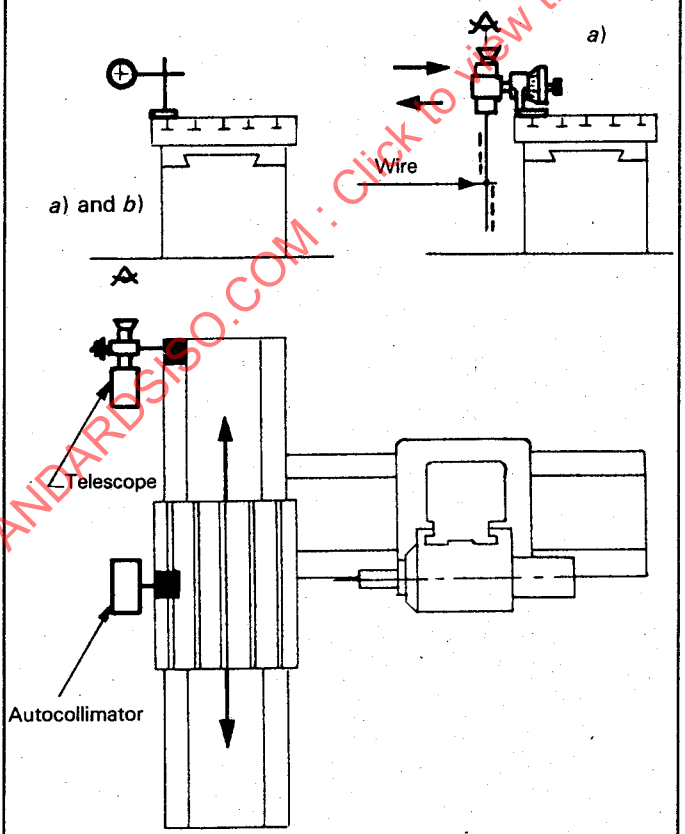
n	Object	Permissible deviation	
		mm	in
	A – TABLE AND COLUMN BEDS		
 2)	Verification of levelling of slideways :		
	a) Checking of bed lengthwise :	*a)* 0,02	*a)* 0.0008
	– straightness of slideways in the vertical plane	up to 1000	up to 40
	1) table bed;	For each 1000 mm (40 in) increase in length, add to the preceding tolerance	
	2) column bed.	0,01	0.0004
		Local tolerance :	
		0,006	0.00024
		over any measuring length of	
 *b)*		300	12
		Maximum permissible deviation :	
		0,05	0.002
	b) Checking of bed crosswise :	*b)* Variation of level :	
	– slideways should be in the same plane	0,02/1000	0.0008/40
	1) table bed;		
	2) column bed.		
 A	Checking of straightness of the slideways in a horizontal plane :	0,02	0.0008
		up to 1000	up to 40
	1) table bed;	For each 1000 mm (40 in) increase in length, add to the preceding tolerance	
	2) column bed.	0,01	0.0004
		Local tolerance :	
		0,006	0.00024
		over any measuring length of	
		300	12
		Maximum permissible deviation :	
		0,05	0.002

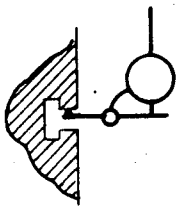
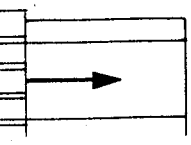
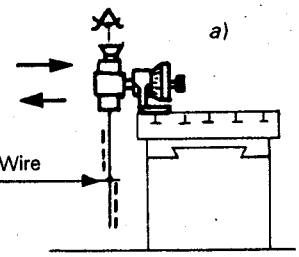
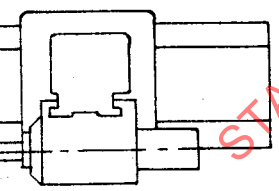
Permissible deviation			Measuring instruments	Observations and references to the test code ISO/R 230
mm		in		
0,02	*a)*	0.0008	Precision level, optical or other methods	*a)* Clauses 3.11, 3.21, 5.212.21 or 5.212.22 Measurements shall be made at a number of positions equally spaced along the length of the beds, table and column placed at the ends then at the middle of their traverse.
up to 1000		up to 40		
1000 mm (40 in) increase in length, add to the preceding				
0,01		0.0004		
Local tolerance :				
0,006		0.00024		
over any measuring length of				
300		12		
Maximum permissible deviation :				
0,05		0.002		
Variation of level :			Precision level and support	*b)* Clause 5.412.7 A level shall be placed transversely and measurements taken at a number of positions equally spaced along the length of the bed. The variation of level at any position shall not exceed the permissible deviation.
0,02/1000		0.0008/40		
0,02		0.0008	Microscope and taut wire or other optical methods	Clauses 5.212.3 or 5.212.22 or 5.232.1 The microscope or the dial gauge shall be fixed on a support **A** of a suitable form such that it can slide in the slideways and shall sight or touch, in the horizontal plane, the taut wire or a straightedge laid parallel to the slideways. The taut wire or the straightedge shall be placed on a fixed part, independent of or integral with the machine and as near as possible to the slideways to be checked. **Observations :** The microscope or the dial gauge can be fixed on the column itself if the column bed is short. NOTE — Such checking is valid only under such conditions where the displacement of the moving elements on the beds is sufficient for measurements to be taken over the whole bed length.
up to 1000		up to 40		
1000 mm (40 in) increase in length, add to the preceding				
0,01		0.0004		
Local tolerance :				
0,006		0.00024		
over any measuring length of				
300		12	Dial gauge, straightedge and support	
Maximum permissible deviation :				
0,05		0.002		

No.	Diagram	Object	
G 3		**B — TABLE** Checking of flatness of the table surface.	Fo tol
G 4		Checking of parallelism of the table surface to its movement.	For tol
G 5		Checking of the straightness of the median or reference T-slot of the table.	

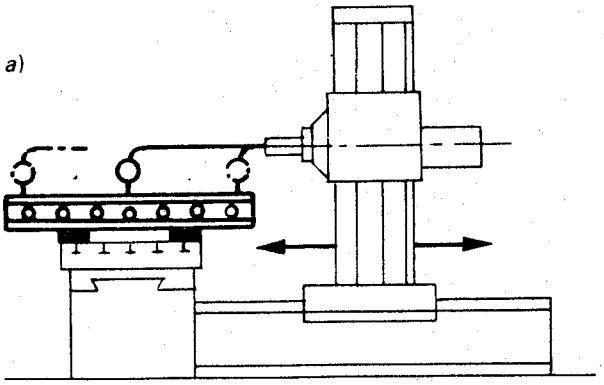
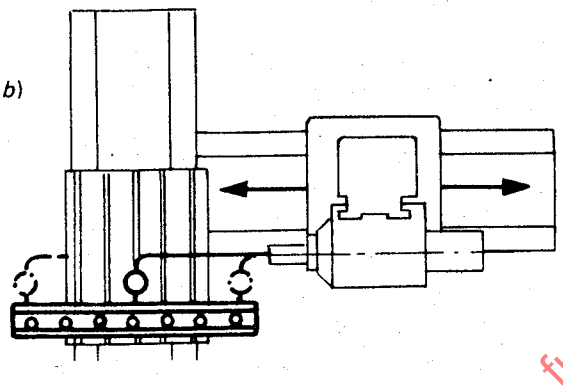
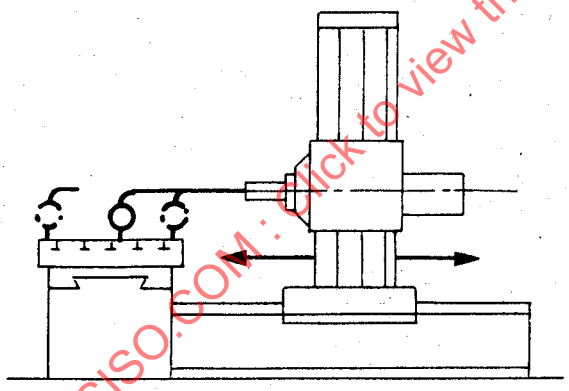
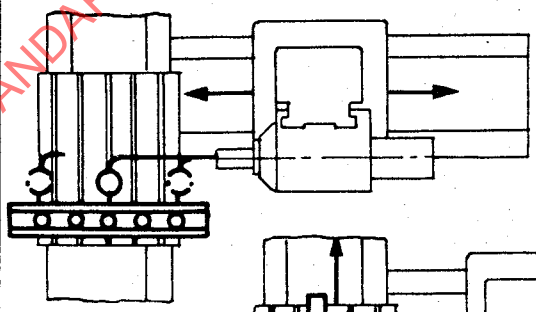
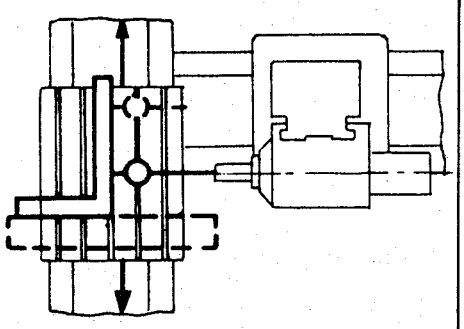
m	Object	Permissible deviation	
		mm	in
	**B — TABLE** Checking of flatness of the table surface.	0,02 up to 1000 (flat to concave) For each 1000 mm (40 in) increase in length, add to the preceding tolerance : 0,02 Local tolerance : 0,015 over any measuring length of 300 Maximum permissible deviation : 0,08	0.0008 up to 40 0.0008 0.0006 12 0.0032
	Checking of parallelism of the table surface to its movement.	0,04 up to 1000 For each 1000 mm (40 in) increase in length, add to the preceding tolerance : 0,01 Local tolerance : 0,015 over any measuring length of 300 Maximum permissible deviation : 0,06	0.0016 up to 40 0.0004 0.0006 12 0.0024
	Checking of the straightness of the median or reference T-slot of the table.	0,02 for any measuring length of 1000 Maximum permissible deviation : 0,03	0.0008 40 0.0012

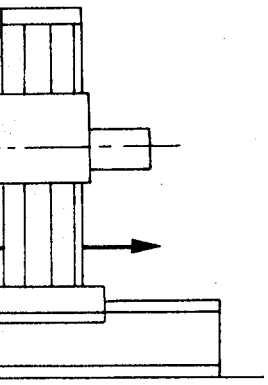
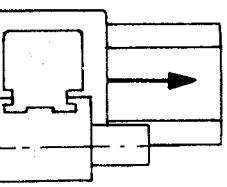
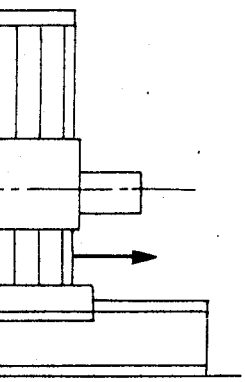
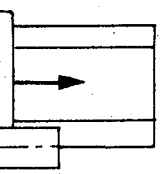
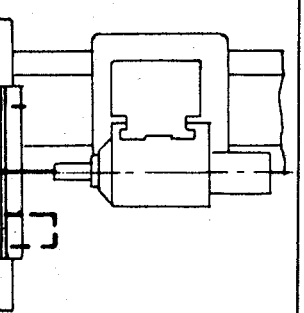
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,02	0.0008	Precision level or straightedge and gauge blocks	Clauses 5.322 and 5.323 Table in its mid-position and locked on its bed.
up to 1000	up to 40		
(flat to concave)			
1000 mm (40 in) increase in length, add to the preceding :			
0,02	0.0008		
Local tolerance :			
0,015	0.0006		
over any measuring length of			
300	12		
Maximum permissible deviation :			
0,08	0.0032		
0,04	0.0016	Straightedge, gauge blocks and dial gauge	Clauses 5.232.1 or 5.422.21 The stylus of the dial gauge shall be placed approximately in a vertical plane containing the spindle axis. Measurement may be made on a straightedge laid parallel to the table surface. If the table length is greater than 1600 mm (64 in), carry out the inspection 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, the dial gauge shall be placed on a fixed part of the machine. **Case of rotary tables :** Instead of a single check, four checks shall be made by rotating the table four times of 90°. Use the greatest of the four deviations observed as the parallelism deviation (ISO 3070/1 — Addendum 1).
up to 1000	up to 40		
1000 mm (40 in) increase in length, add to the preceding :			
0,01	0.0004		
Local tolerance :			
0,015	0.0006		
over any measuring length of			
300	12		
Maximum permissible deviation :			
0,06	0.0024		
0,02	0.0008	Straightedge and dial gauge, or microscope and taut wire	Clauses 5.212, 5.212.1, 5.212.3 or 5.232 The straightedge may be set directly on the table.
for any measuring length of			
1000	40		
Maximum permissible deviation :			
0,03	0.0012		

No.	Diagram	Object	
G 6		Checking of parallelism of the median or reference T-slot to the table movement.	
G 7		Checking of straightness of the table movement : *a)* in a horizontal plane; *b)* in a vertical plane.	For tole

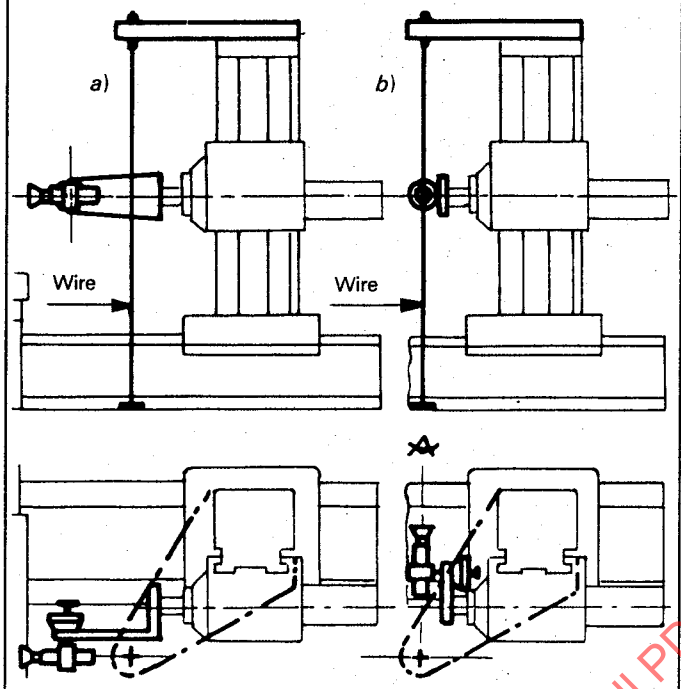
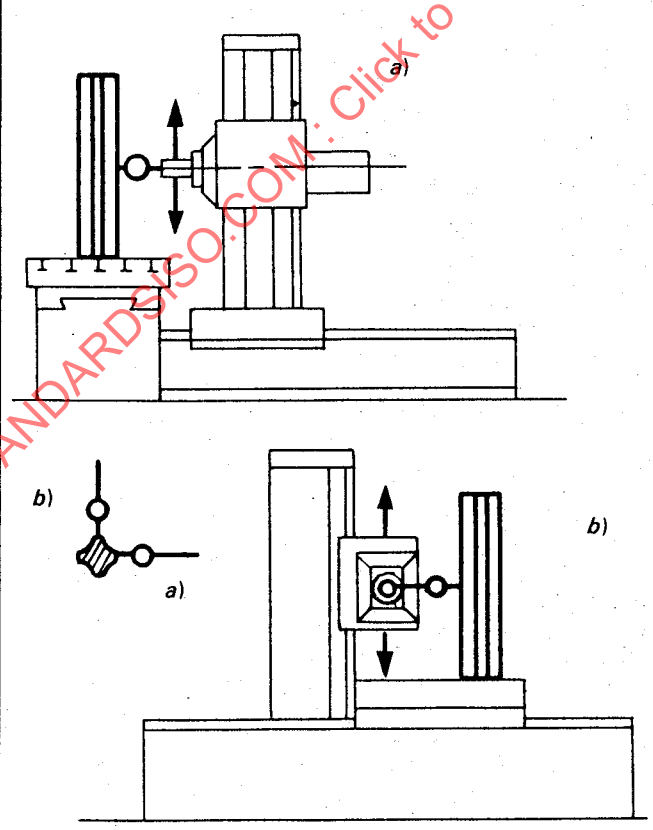
n	Object	Permissible deviation	
		mm	in
 	Checking of parallelism of the median or reference T-slot to the table movement.	0,03 over any length of 1000 Maximum permissible deviation : 0,04	0.0012 40 0.0016
 	Checking of straightness of the table movement : *a)* in a horizontal plane; *b)* in a vertical plane.	For *a)* and *b)* : 0,02 up to 1000 For each 1000 mm (40 in) increase in length, add to the preceding tolerance : 0,01	 0.0008 up to 40 0.0004

Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
0,03	0.0012	Dial gauge	Clauses 5.232.1 and 5.422.21 Column locked on its bed. If the spindle can be locked, the dial gauge may be mounted on it; otherwise, it shall be mounted on a fixed part of the machine
over any length of			
1000	40		
Maximum permissible deviation :			
0,04	0.0016		
For *a*) and *b*) :		Optical methods (alignment telescope, autocollimator, laser, etc.) and taut wire [for *a*) only] and level [for *b*) only]	Clauses 5.212.22 or 5.212.3 and 5.232.2
0,02	0.0008		
up to 1000	up to 40		
1000 mm (40 in) increase in length, add to the preceding			
e :			
0,01	0.0004		

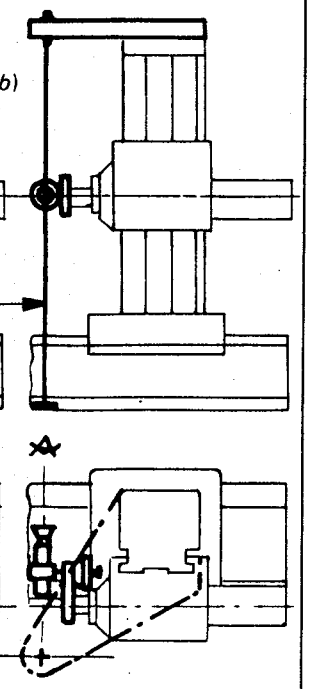
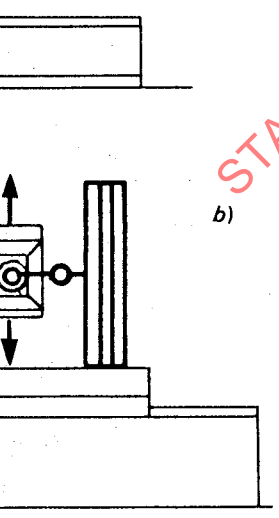
No.	Diagram	Object
G 8	a)  b) 	**C – COLUMN** Checking of straightness of the column movement : *a)* in a vertical plane; *b)* in a horizontal plane.
G 9		Checking of parallelism of the column movement to the table surface.
G 10	a)  b) 	Checking of squareness of the column movement (W axis) to the table movement (X axis)

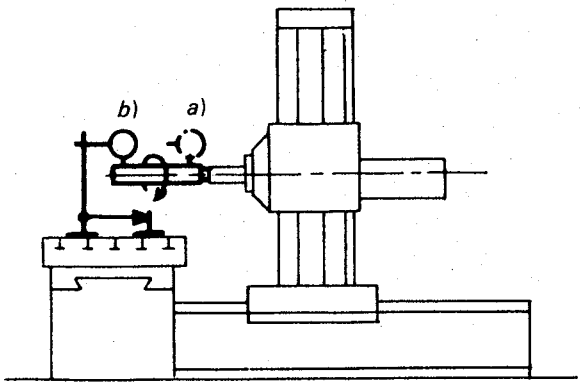
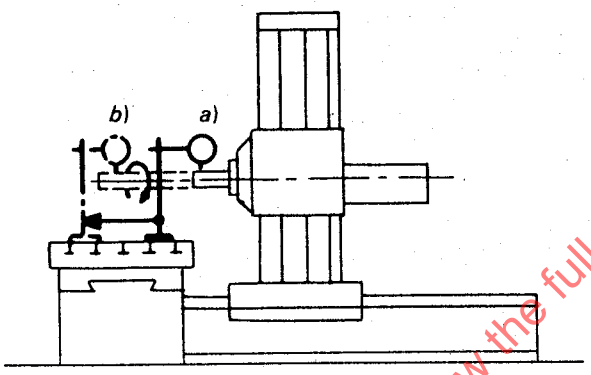
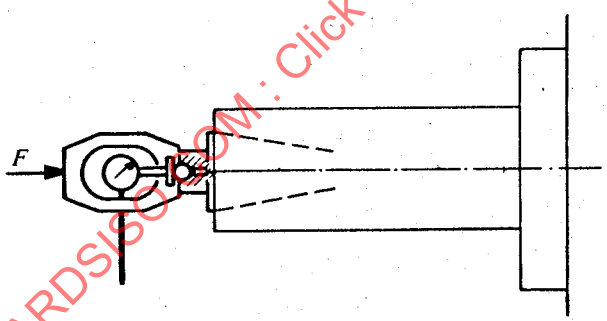
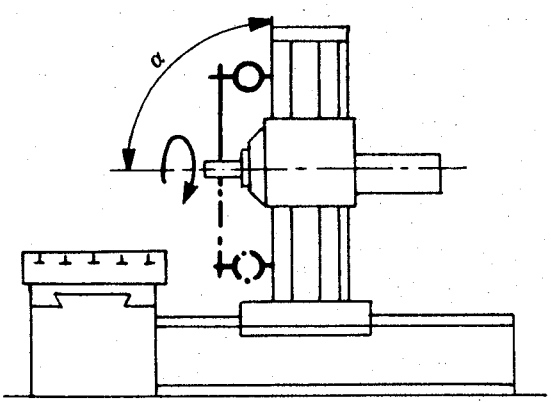
n	Object	Permissible deviation	
		mm	in
 	**C — COLUMN** Checking of straightness of the column movement : *a*) in a vertical plane; *b*) in a horizontal plane.	For *a*) and *b*) : 0,02 up to 1000 0,03 above 1000	 0.0008 up to 40 0.0012 above 40
	Checking of parallelism of the column movement to the table surface.	0,04 up to 1000 0,06 above 1000 Local tolerance : 0,015 over 300	0.0016 up to 40 0.0024 above 40 0.0006 over 12
a)  	Checking of squareness of the column movement (W axis) to the table movement (X axis)	0,03/1000	0.0012/40

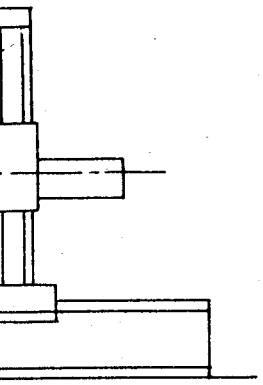
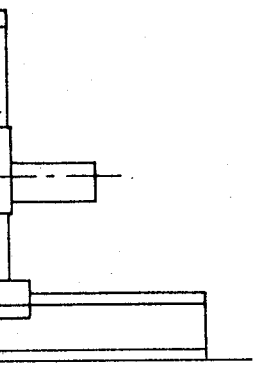
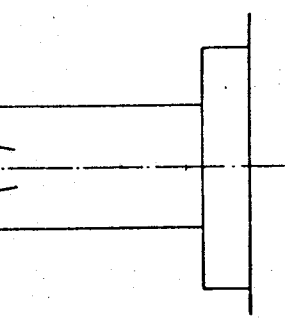
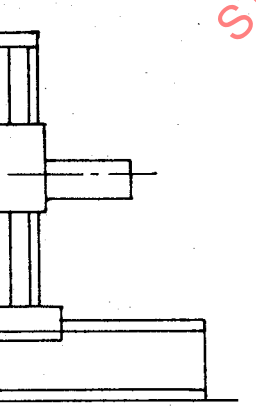
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
For *a*) and *b*) :			Clause 5.232.1
0,02 up to 1000 0,03 above 1000	0.0008 up to 40 0.0012 above 40	Dial gauge, straightedge and gauge blocks or optical methods	The straightedge shall be placed on the table and laid parallel to the slideways of the column bed (table and spindle head locked). For checking *a*), the straightedge is laid vertically on edge and for test *b*) horizontally and flat
0,04 up to 1000 0,06 above 1000	0.0016 up to 40 0.0024 above 40	Dial gauge	Clause 5.422.22 Table locked on its bed. The dial gauge can touch a straightedge laid on the table.
Local tolerance :			
0,015 over 300	0.0006 over 12		
0,03/1000	0.0012/40	Dial gauge, straightedge and squares or optical methods	Clauses 5.522.4 and 5.212.22 Spindle head placed in mid-travel and locked. *a*) The straightedge shall be set parallel to the column longitudinal movement and fixed; then the square shall be placed against the straightedge. *b*) The movement of the table shall then be checked. If the spindle can be locked, then the dial gauge may be mounted on it. If the spindle cannot be locked the dial gauge shall be placed on a fixed part of the machine.

No.	Diagram	Object
G 11		**D — SPINDLE HEAD** Checking of straightness of the vertical spindle head movement (axis Y) on the column : *a)* in the vertical plane containing the spindle axis; *b)* in the vertical plane perpendicular to the spindle axis.
G 12		Checking of squareness of the vertical spindle head movement (axis Y) to the table surface : *a)* in the vertical plane containing the spindle axis; *b)* in a plane perpendicular to the spindle axis.

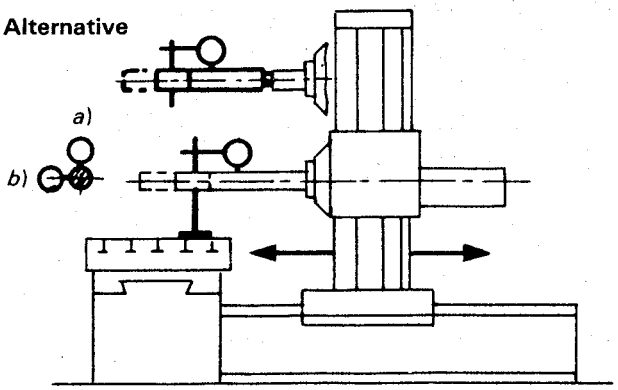
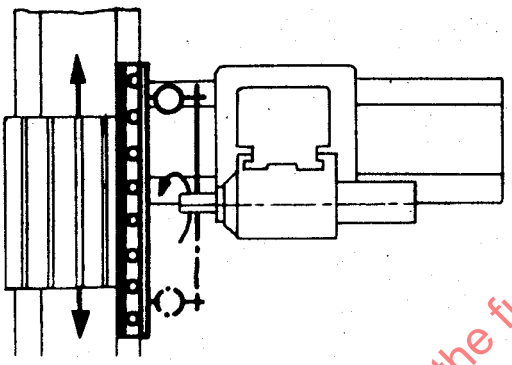
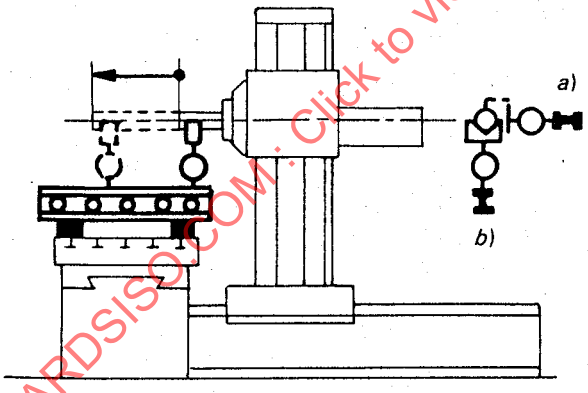
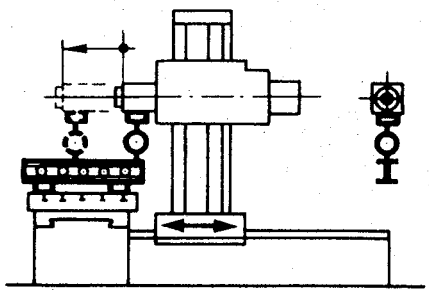
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
For *a*) and *b*) :		Microscope and taut wire or optical methods	Clauses 5.212.3, 5.232.2 or 5.212.22 Carry out the test with the column and table locked, table in mid-position. The taut wire shall be tightened between fixed parts independent of or integral with the machine, and as near as possible to the vertical slideways of the column. If the spindle can be locked, the microscope or the alignment telescope can be mounted on it. If the spindle cannot be locked, the alignment telescope shall be placed on the spindle head of the machine. The spindle head shall be locked during measurements.
0,02	0.0008		
up to 1000	up to 40		
1000 mm (40 in) increase in length, add to the preceding :			
0,01	0.0004		
for the machines having a stroke :			
< 4000	< 160		
0,02	0.0008		
for the machines with a bigger stroke			
For *a*) and *b*) :		Dial gauge and square or optical methods	Clauses 5.522.2 or 5.212.22 Carry out the test with the column and table locked. The spindle head shall be locked during measurements. If the spindle can be locked, the dial gauge can be mounted on it. If the spindle cannot be locked, it shall be placed on the spindle head of the machine.
0,03/1000	0.0012/40		

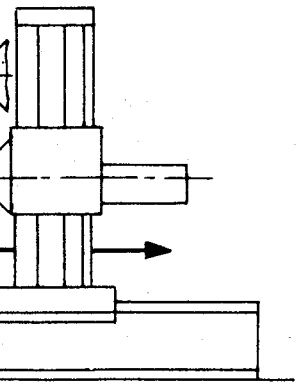
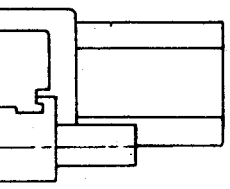
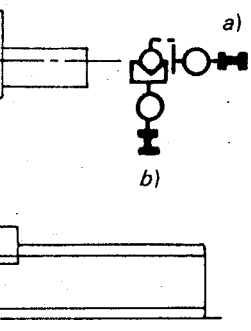
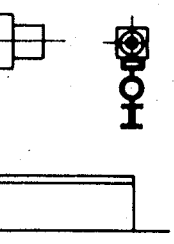
	Object	Permissible deviation	
		mm	in
	**D — SPINDLE HEAD** Checking of straightness of the vertical spindle head movement (axis Y) on the column : *a*) in the vertical plane containing the spindle axis; *b*) in the vertical plane perpendicular to the spindle axis.	For *a*) and *b*) : 0,02 up to 1000 For each 1000 mm (40 in) increase in length, add to the preceding tolerance : 0,01 for the machines having a stroke : < 4000 0,02 for the machines with a bigger stroke	 0.0008 up to 40 0.0004 < 160 0.0008
	Checking of squareness of the vertical spindle head movement (axis Y) to the table surface : *a*) in the vertical plane containing the spindle axis; *b*) in a plane perpendicular to the spindle axis.	For *a*) and *b*) : 0,03/1000	 0.0012/40

No.	Diagram	Object	
G 13		**E — BORING SPINDLE** Measurement of run-out of the internal taper of the boring spindle : *a*) at the mouth of taper; *b*) at a distance of 300 mm (12 in) from the spindle nose.	*a*) *b*) *a*) *b*)
G 14		Measurement of run-out of the boring spindle : *a*) spindle retracted; *b*) spindle extended 300 mm (12 in) (sliding spindle).	*a*) *b*) *a*) *b*)
G 15		Measurement of periodic axial slip of the boring spindle (spindle retracted).	
G 16		Checking of squareness of the boring spindle axis to the column ways.	

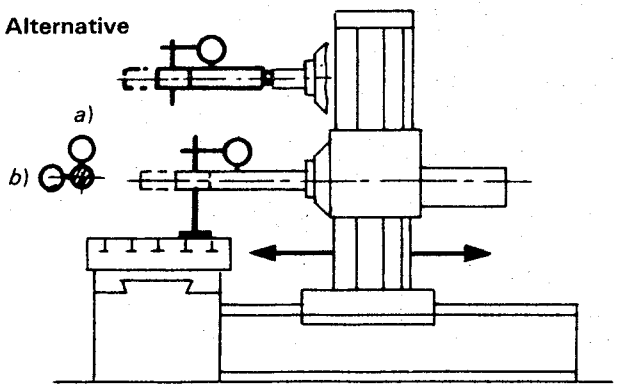
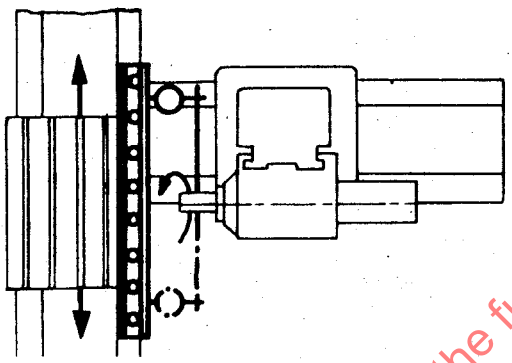
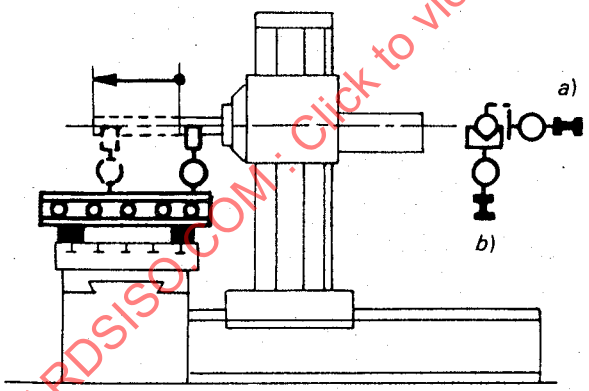
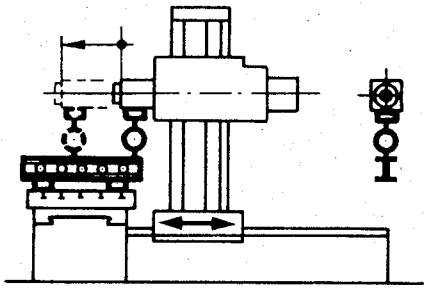
m	Object	Permissible deviation	
		mm	in
	**E — BORING SPINDLE** Measurement of run-out of the internal taper of the boring spindle : *a)* at the mouth of taper; *b)* at a distance of 300 mm (12 in) from the spindle nose.	For D[1] < 125 : *a)* 0,01 *b)* 0,02 For D[1] > 125 : *a)* 0,015 *b)* 0,030	For D[1] < 5 : *a)* 0.0004 *b)* 0.0008 For D[1] > 5 : *a)* 0.0006 *b)* 0.0012
	Measurement of run-out of the boring spindle : *a)* spindle retracted; *b)* spindle extended 300 mm (12 in) (sliding spindle).	For D[1] < 125 : *a)* 0,01 *b)* 0,02 For D[1] > 125 : *a)* 0,015 *b)* 0,030	For D[1] < 5 : *a)* 0.0004 *b)* 0.0008 For D[1] > 5 : *a)* 0.0006 *b)* 0.0012
	Measurement of periodic axial slip of the boring spindle (spindle retracted).	For D[1] < 125 : 0,01 For D[1] > 125 : 0,015	For D[1] < 5 : 0.0004 For D[1] > 5 : 0.0006
	Checking of squareness of the boring spindle axis to the column ways.	0,03/1000[1] with α < 90°	0.0012/40[1]

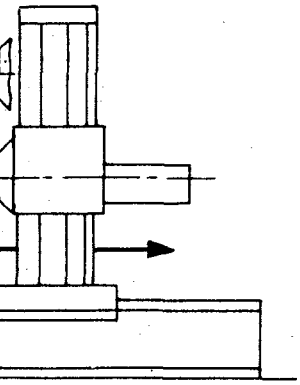
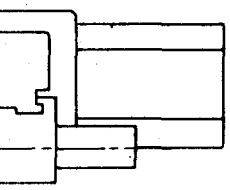
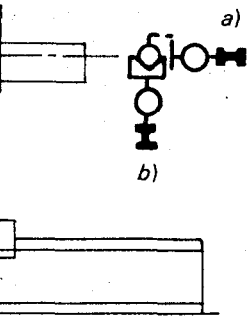
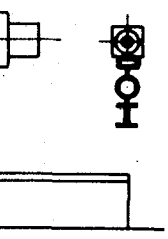
Permissible deviation			Measuring instruments	Observations and references to the test code ISO/R 230
mm		in		
or $D^{1)} \leqslant 125$:		For $D^{1)} \leqslant 5$:	Dial gauge and test mandrel	Clause 5.612.3 Carry out measurements with the spindle retracted (sliding spindle). 1) D = diameter of boring spindle.
0,01	*a)*	0.0004		
0,02	*b)*	0.0008		
or $D^{1)} > 125$:		For $D^{1)} > 5$:		
0,015	*a)*	0.0006		
0,030	*b)*	0.0012		
or $D^{1)} \leqslant 125$:		For $D^{1)} \leqslant 5$:	Dial gauge	Clause 5.612.2 1) D = diameter of boring spindle.
0,01	*a)*	0.0004		
0,02	*b)*	0.0008		
or $D^{1)} > 125$:		For $D^{1)} > 5$:		
0,015	*a)*	0.0006		
0,030	*b)*	0.0012		
or $D^{1)} \leqslant 125$:		For $D^{1)} \leqslant 5$:	Dial gauge	Clauses 5.622.1 and 5.622.2 Carry out this test with the spindle retracted (sliding spindle). The existence, value and the direction of application of the force F shall be stated by the manufacturer. 1) D = diameter of boring spindle.
0,01		0.0004		
or $D^{1)} > 125$:		For $D^{1)} > 5$:		
0,015		0.0006		
0,03/1000[1)]		0.0012/40[1)]	Dial gauge and possibly straightedge	Clauses 5.512.1 and 5.512.42 Column locked in mid-travel on its bed, spindle-head locked in mid-travel on the column, spindle and possibly ram retracted. For large machines for which sizes have a great importance, the measuring reference shall be related to a plane parallel to the column ways. 1) Distance between the two points touched.
with $\alpha \leqslant 90°$				

No.	Diagram	Object	
G 17	Alternative a) b) 	Checking of parallelism of the boring spindle axis to the column movement : *a)* in a vertical plane; *b)* in a horizontal plane.	
G 18		Checking of squareness of the boring spindle axis to the table movement.	
G 19	 a) b)	Checking of straightness of the boring spindle movement (sliding spindle) (axis Z) : *a)* in a horizontal plane; *b)* in a vertical plane.	*a)* *b)*
G 20		Checking of parallelism of the sliding movement of the boring spindle, in relation to a reference plane parallel to the longitudinal movement of the column (axis W).	For For dia For dia NO dia

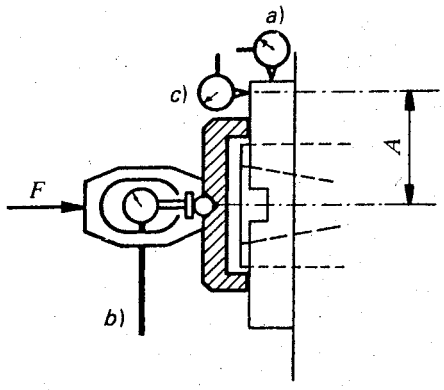
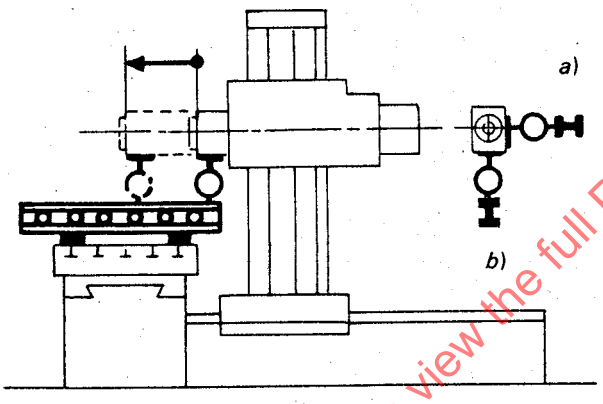
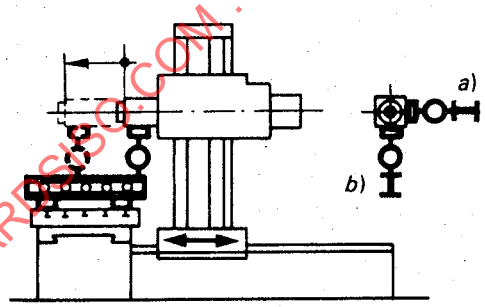
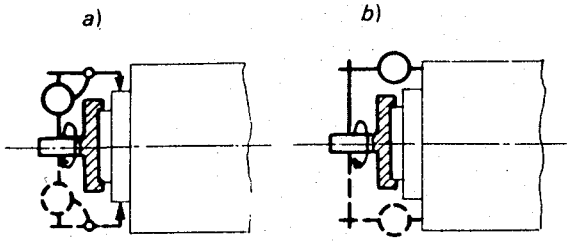
m	Object	Permissible deviation	
		mm	in
	Checking of parallelism of the boring spindle axis to the column movement : *a)* in a vertical plane; *b)* in a horizontal plane.	For *a)* and *b)* : 0,02 for a measuring length of 300	0.0008 12
	Checking of squareness of the boring spindle axis to the table movement.	0,02/500	0.0008/20
	Checking of straightness of the boring spindle movement (sliding spindle) (axis Z) : *a)* in a horizontal plane; *b)* in a vertical plane.	*a)* 0,02 for a measuring length of 300 *b)* 0,02 for a measuring length of 300	*a)* 0.0008 12 *b)* 0.0008 12
	Checking of parallelism of the sliding movement of the boring spindle, in relation to a reference plane parallel to the longitudinal movement of the column (axis W).	For an extension of the spindle equal to twice the spindle diameter : + 0,015 (upwards) For an extension of the spindle equal to four times the spindle diameter : ± 0,02 For an extension of the spindle equal to six times the spindle diameter : − 0,06 (downwards) NOTE — The extension of the spindle is limited to six times the spindle diameter and cannot exceed 900	+ 0.0006 ± 0.0008 − 0.0024 36

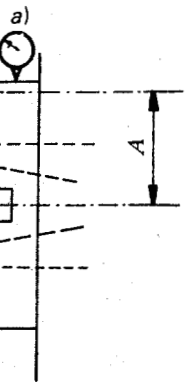
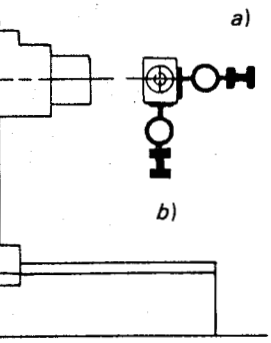
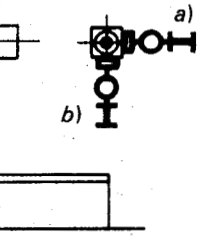
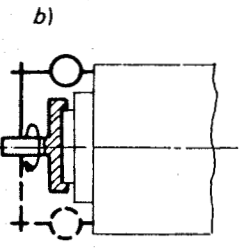
Permissible deviation			Measuring instruments	Observations and references to the test code ISO/R 230
mm		in		
For *a*) and *b*) :			Dial gauge and possibly test mandrel	Clauses 5.412.1 and 5.422.3 Spindle head locked in mid-travel, table locked. The measurement shall be carried out according to the possibilities either touching directly the external part of the boring spindle or with the aid of a test mandrel mounted in the spindle nose (alternative).
0,02		0.0008		
for a measuring length of				
300		12		
0,02/500		0.0008/20	Straightedge and dial gauge	Clause 5.522.3 Column and spindle head locked, spindle head in mid-travel. A straightedge laid on the table will be set parallel to the table movement.
0,02	*a*)	0.0008	Straightedge, gauge blocks and dial gauge	Clause 5.232.1 Spindle head locked. The straightedge shall be set parallel to the axial spindle movement; then touch the functional surface of the straightedge with the stylus of a dial gauge fixed on the spindle nose. Repeat the same operations in the two planes : horizontal and vertical. In the case of a machine having a ram, it shall be maintained locked, in the retracted position.
for a measuring length of				
300		12		
0,02	*b*)	0.0008		
for a measuring length of				
300		12		
tension of the spindle equal to twice the spindle diameter :			Straightedge, gauge blocks and dial gauge	Clause 5.232.1 Place a straightedge on the machine table and align it, in the vertical containing the spindle. Adjust the straightedge to bring it in a horizontal plane parallel to the column movement. Touch the functional surface of the straightedge with a dial gauge fixed on the spindle nose. Extend the spindle of the requested length and note the dial gauge readings for each of the successive positions.
+ 0,015		+ 0.0006		
(upwards)				
xtension of the spindle equal to four times the spindle :				
± 0,02		± 0.0008		
xtension of the spindle equal to six times the spindle :				
− 0,06		− 0.0024		
(downwards)				
The extension of the spindle is limited to six times the spindle nd cannot exceed				
900		36		

No.	Diagram	Object	
G 17	Alternative a) b) 	Checking of parallelism of the boring spindle axis to the column movement : *a)* in a vertical plane; *b)* in a horizontal plane.	
G 18		Checking of squareness of the boring spindle axis to the table movement.	
G 19	 a) b)	Checking of straightness of the boring spindle movement (sliding spindle) (axis Z) : *a)* in a horizontal plane; *b)* in a vertical plane.	*a)* *b)*
G 20		Checking of parallelism of the sliding movement of the boring spindle, in relation to a reference plane parallel to the longitudinal movement of the column (axis W).	For For dia For dia NO dia

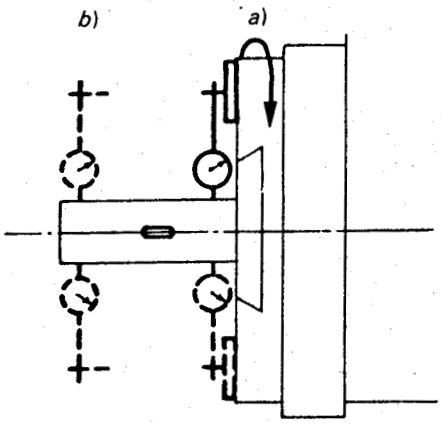
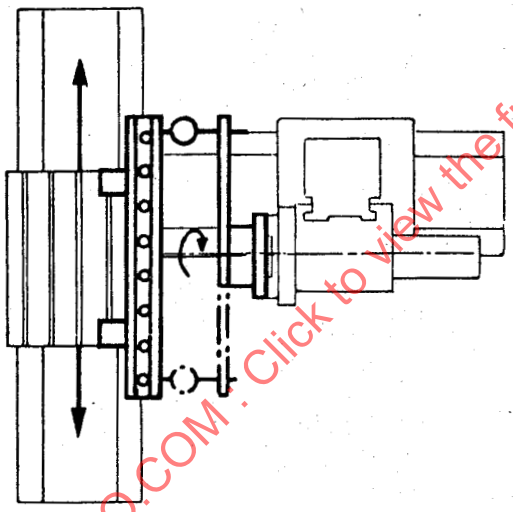
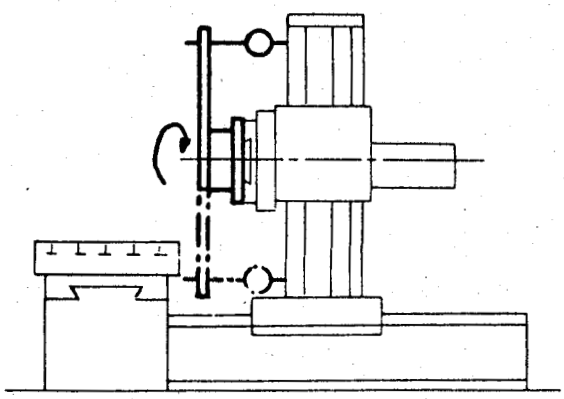
am	Object	Permissible deviation	
		mm	in
	Checking of parallelism of the boring spindle axis to the column movement : *a*) in a vertical plane; *b*) in a horizontal plane.	For *a*) and *b*) : 0,02 for a measuring length of 300	0.0008 12
	Checking of squareness of the boring spindle axis to the table movement.	0,02/500	0.0008/20
	Checking of straightness of the boring spindle movement (sliding spindle) (axis Z) : *a*) in a horizontal plane; *b*) in a vertical plane.	*a*) 0,02 for a measuring length of 300 *b*) 0,02 for a measuring length of 300	*a*) 0.0008 12 *b*) 0.0008 12
	Checking of parallelism of the sliding movement of the boring spindle, in relation to a reference plane parallel to the longitudinal movement of the column (axis W).	For an extension of the spindle equal to twice the spindle diameter : + 0,015 (upwards) For an extension of the spindle equal to four times the spindle diameter : ± 0,02 For an extension of the spindle equal to six times the spindle diameter : − 0,06 (downwards) NOTE — The extension of the spindle is limited to six times the spindle diameter and cannot exceed 900	+ 0.0006 ± 0.0008 − 0.0024 36

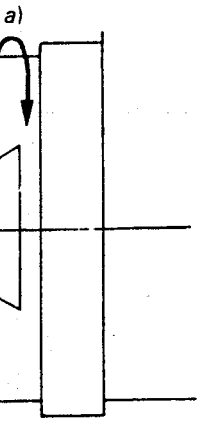
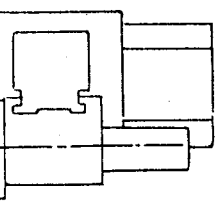
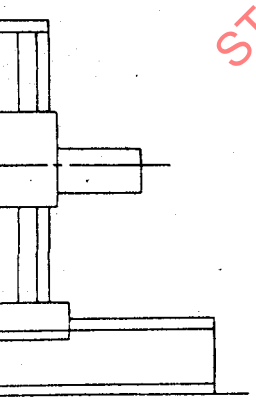
Permissible deviation		Measuring instruments	Observations and references to the test code ISO/R 230
mm	in		
For *a*) and *b*) : 0,02 for a measuring length of 300	0.0008 12	Dial gauge and possibly test mandrel	Clauses 5.412.1 and 5.422.3 Spindle head locked in mid-travel, table locked. The measurement shall be carried out according to the possibilities either touching directly the external part of the boring spindle or with the aid of a test mandrel mounted in the spindle nose (alternative).
0,02/500	0.0008/20	Straightedge and dial gauge	Clause 5.522.3 Column and spindle head locked, spindle head in mid-travel. A straightedge laid on the table will be set parallel to the table movement.
0,02 *a*) for a measuring length of 300 0,02 *b*) for a measuring length of 300	0.0008 12 0.0008 12	Straightedge, gauge blocks and dial gauge	Clause 5.232.1 Spindle head locked. The straightedge shall be set parallel to the axial spindle movement; then touch the functional surface of the straightedge with the stylus of a dial gauge fixed on the spindle nose. Repeat the same operations in the two planes : horizontal and vertical. In the case of a machine having a ram, it shall be maintained locked, in the retracted position.
xtension of the spindle equal to twice the spindle diameter : + 0,015 (upwards) extension of the spindle equal to four times the spindle r : . ± 0,02 extension of the spindle equal to six times the spindle r : − 0,06 (downwards) The extension of the spindle is limited to six times the spindle and cannot exceed 900	+ 0.0006 ± 0.0008 − 0.0024 36	Straightedge, gauge blocks and dial gauge	Clause 5.232.1 Place a straightedge on the machine table and align it, in the vertical containing the spindle. Adjust the straightedge to bring it in a horizontal plane parallel to the column movement. Touch the functional surface of the straightedge with a dial gauge fixed on the spindle nose. Extend the spindle of the requested length and note the dial gauge readings for each of the successive positions.

No.	Diagram	Object	
G 21		**F — MILLING SPINDLE** *a)* Measurement of run-out of the milling spindle; *b)* Measurement of periodic axial slip; *c)* Measurement of camming of the face of the spindle nose (including periodic axial slip.	*a)* *b)* *c)* *a)* *b)* *c)*
G 22		**G — RAM** Checking of straightness of the ram movement : *a)* in a horizontal plane; *b)* in a vertical plane.	*a)* *b)*
G 23		Checking of parallelism of the ram movement to the column movement : *a)* in a horizontal plane; *b)* in a vertical plane.	
G 24		*a)* Checking of concentricity of the milling spindle and of the front centring of tools for accessories on the ram; *b)* Checking of squareness of the support surface of tools or accessories to the rotation axis of the milling surface.	*a)* *b)*

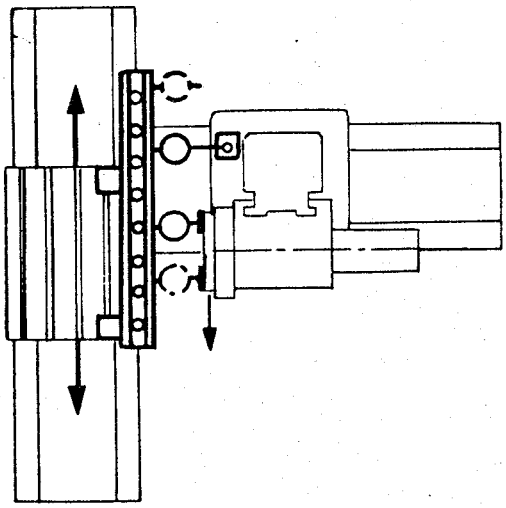
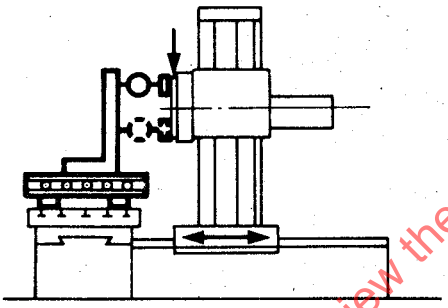
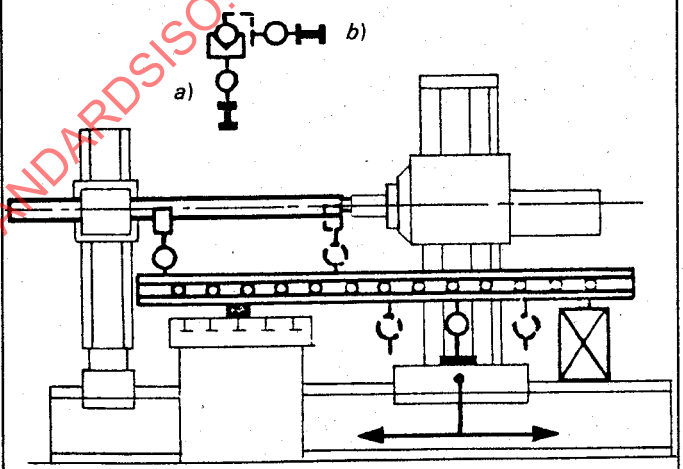
	Object	Permissible deviation	
		mm	in
	**F — MILLING SPINDLE** *a*) Measurement of run-out of the milling spindle; *b*) Measurement of periodic axial slip; *c*) Measurement of camming of the face of the spindle nose (including periodic axial slip.	For D[1] ≤ 125 : *a*) 0,01 *b*) 0,01 *c*) 0,02 For D[1] > 125 : *a*) 0,015 *b*) 0,015 *c*) 0,030	For D[1] ≤ 5 : *a*) 0.0004 *b*) 0.0004 *c*) 0.0008 For D[1] > 5 : *a*) 0.0006 *b*) 0.0006 *c*) 0.0012
	**G — RAM** Checking of straightness of the ram movement : *a*) in a horizontal plane; *b*) in a vertical plane.	*a*) 0,02 for a measuring length of 500 *b*) 0,02 for a measuring length of 500	*a*) 0.0008 for a measuring length of 20 *b*) 0.0008 for a measuring length of 20
	Checking of parallelism of the ram movement to the column movement : *a*) in a horizontal plane; *b*) in a vertical plane.	For *a*) and *b*) : 0,03 for a measuring length of 500	0.0012 for a measuring length of 20
	*a*) Checking of concentricity of the milling spindle and of the front centring of tools for accessories on the ram; *b*) Checking of squareness of the support surface of tools or accessories to the rotation axis of the milling surface.	*a*) 0,02 *b*) 0,02/500	*a*) 0.0008 *b*) 0.0008/20

Permissible deviation			Measuring instruments	Observations and references to the test code ISO/R 230
mm		in		
For D [1] < 125 :		For D [1] < 5 :	Dial gauge	*a*) Clause 5.612.2 *b*) Clauses 5.622.1 and 5.622.2 The existence, value and direction of application of the force F shall be stated by the manufacturer. *c*) Clause 5.632 The distance A of dial gauge *c*) from the spindle axis shall be as large as possible. 1) D = diameter of boring spindle.
0,01	*a*)	0.0004		
0,01	*b*)	0.0004		
0,02	*c*)	0.0008		
For D [1] > 125 :		For D [1] > 5 :		
0,015	*a*)	0.0006		
0,015	*b*)	0.0006		
0,030	*c*)	0.0012		
0,02	*a*)	0.0008	Straightedge, gauge blocks and dial gauge	Clause 5.232.1 Spindle head locked. Boring spindle retracted. Set the straightedge on the table, parallel to the ram movement; then touch the functional surface of the straightedge with the stylus of a dial gauge fixed at the end of the ram. Repeat the same operations in the two planes : horizontal and vertical.
for a measuring length of				
500		20		
0,02	*b*)	0.0008		
for a measuring length of				
500		20		
For *a*) and *b*) :			Straightedge, gauge blocks and dial gauge	Clauses 5.422.21 and 5.422.22 A straightedge shall be set parallel to the column movement (W axis), and then the column locked in mid-travel. The ram movement shall then be checked with respect to the straightedge. Spindle head locked.
0,03		0.0012		
for a measuring length of				
500		20		
0,02	*a*)	0.0008	Dial gauge	*a*) Clause 5.442
0,02/500	*b*)	0.0008/20		*b*) Clause 5.512.42 NOTE — This operation is valid only if there is a circular locating surface on the ram.

No.	Diagram	Object	
G 25		**H — INTEGRAL FACING HEAD** Checking of coaxiality of the boring spindle axis and of the facing head axis (in the case of independent rotation movements of the spindle and of the facing head) : *a*) at the mouth of spindle housing; *b*) at a distance from the spindle housing face equal to 300 mm (12 in).	*a*) *b*) *a*) *b*)
G 26		Checking of squareness of the facing head axis to the table movement.	
G 27		Checking of squareness of the facing head axis to the column ways.	

	Object	Permissible deviation	
		mm	in
	**H — INTEGRAL FACING HEAD** Checking of coaxiality of the boring spindle axis and of the facing head axis (in the case of independent rotation movements of the spindle and of the facing head) : *a)* at the mouth of spindle housing; *b)* at a distance from the spindle housing face equal to 300 mm (12 in).	D[1] ⩽ 125 : *a)* 0,02 *b)* 0,03 D[1] > 125 : *a)* 0,03 *b)* 0,04	D[1] ⩽ 5 : *a)* 0.0008 *b)* 0.0012 D[1] > 5 : *a)* 0.0012 *b)* 0.0016
	Checking of squareness of the facing head axis to the table movement.	0,03/1000[1]	0.0012/40[1]
	Checking of squareness of the facing head axis to the column ways.	0,03/1000[1]	0.0012/40[1]

Permissible deviation			Measuring instruments	Observations and references to the test code ISO/R 230
mm		in		
$D^{1)} \leqslant 125$:		$D^{1)} \leqslant 5$:	*Dial gauge*	Clause 5.442 A dial gauge fixed on the facing head shall touch the spindle at the mouth and at 300 mm (12 in). For each operation, half the difference of the *extreme readings* shall be made to obtain the coaxiality deviation. This check is valid only if the facing head is mounted on bearings independent of those of the boring spindle. 1) D = diameter of boring spindle.
0,02	*a)*	0.0008		
0,03	*b)*	0.0012		
$D^{1)} > 125$:		$D^{1)} > 5$:		
0,03	*a)*	0.0012		
0,04	*b)*	0.0016		
0,03/1000[1)]		0.0012/40[1)]	*Dial gauge on rigid support and straightedge*	Clauses 5.522.3 or 5.512.1 and 5.512.42 Column and spindle head locked. A straightedge laid on the table shall be set parallel to the table movement (X axis). This check is valid only if the facing head is mounted on bearings independent of those of the boring spindle. 1) Distance between the two points touched.
0,03/1000[1)]		0.0012/40[1)]	Dial gauge on rigid support and possibly straightedge	Clauses 5.512.1 and 5.512.42 Column locked on its bed; spindle head locked in mid-travel on the column. For large machines for which sizes are too large, the measuring reference shall be related to a plane parallel to the column slideways. This check is valid only if the facing head is mounted on bearings independent of those of the boring spindle. 1) Distance between the two points touched.

No.	Diagram	Object	
G 28		**Radial facing slide** Checking (in the horizontal plane) of parallelism of the radial facing slide movement to the table movement (X axis).	
G 29		Checking (in the vertical plane) of squareness of the radial facing slide movement to the column movement.	
G 30		**J — STEADY BLOCK** Checking of coincidence of the steady block bore with the boring spindle axis : *a)* in the vertical plane (in the case of machines having synchronized movements of the steady block and spindle head); *b)* in the horizontal plane.	*a)* *b)*