International Standard 1986

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Acceptance conditions for surface grinding machines with horizontal grinding wheel spindle and reciprocating table — Testing of accuracy

Conditions de réception des machines à rectifier les surfaces planes, à broche porte-meule à axe horizontal — Contrôle de la précision

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1986 was prepared by Technical Committee ISO/TC 39, *Machine tools.*

ISO 1986 was first published in 1974. This second edition cancels and replaces the first edition, of which geometrical test G3 (G4 in the previous edition) has been revised technically.

Acceptance conditions for surface grinding machines with horizontal grinding wheel spindle and reciprocating table — Testing of 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 surface grinding machines with reciprocating table and horizontal grinding wheel spindle, and the corresponding permissible deviations which apply.

It is not applicable to surface grinding machines with fixed or rotating tables or to machines having longitudinal traverse of the wheelhead. [1)]

This International Standard 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.), nor to machine characteristics (speeds, feeds, etc.) which should generally be checked before testing accuracy.

2 Preliminary remarks

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

2.2 To apply this International Standard, reference should be made to ISO/R 230, especially for the installation of the machine before testing, warming up of spindles and other moving parts, description of measuring methods and recommended accuracy of testing equipment.

2.3 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and this in no way defines the practical order of testing. In order to make the mounting of instruments or gauging easier, tests may be applied in any order.

2.4 When inspecting a machine, it is not always necessary to carry out all the tests described in this International Standard. It is up to the user to choose, in agreement with the manufacturer, those 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 the tolerance is established for a measuring range different from that given in this International Standard (see 2.311 in ISO/R 230 or when determining permissible deviation by calculation), it should be taken into consideration that the minimum value of tolerance is 0,001 mm (0.000 04 in) for geometrical tests and practical tests.

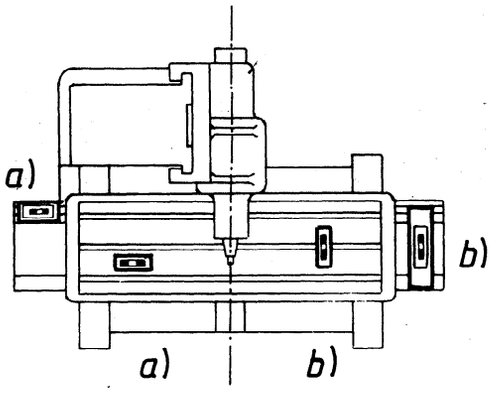
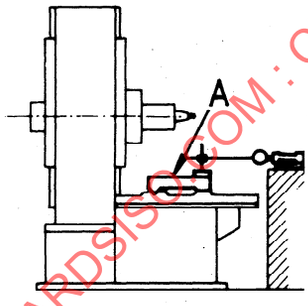
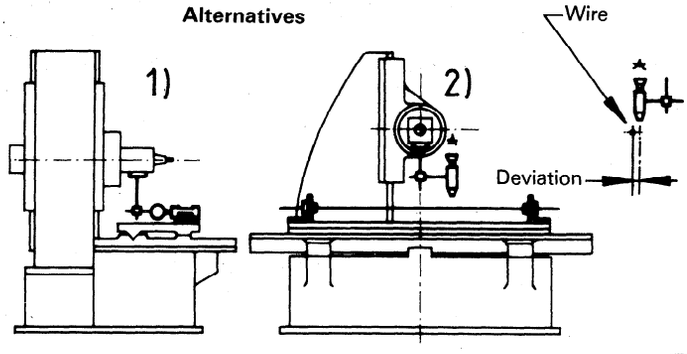
3 Reference

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

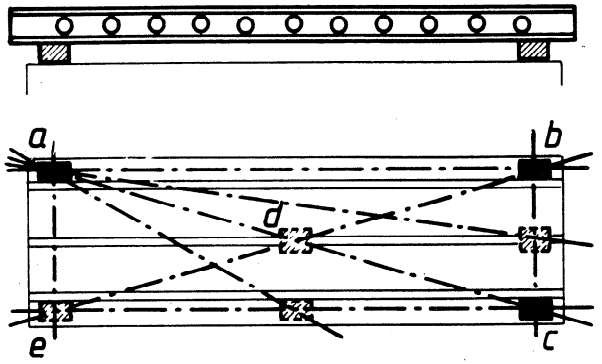
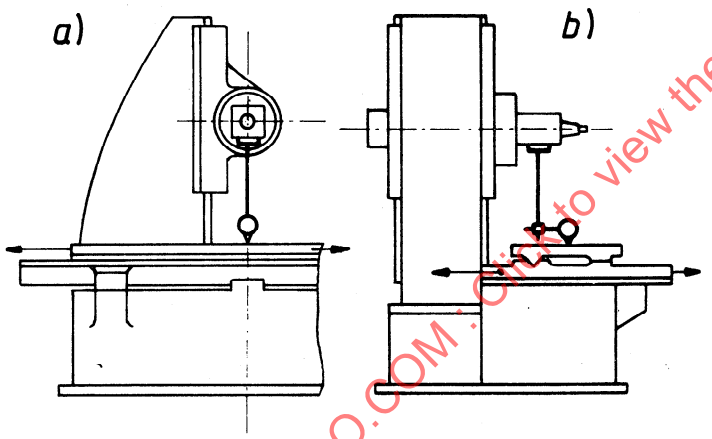
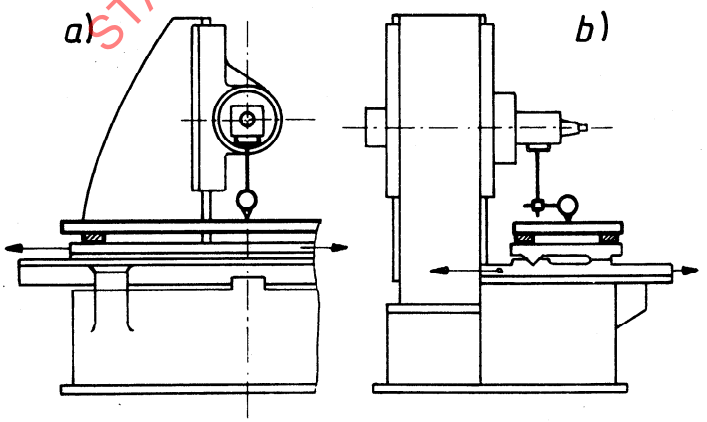
1) For reasons of simplicity, the diagrams in this International Standard illustrate only one type of machine.

4 Acceptance conditions and permissible deviations

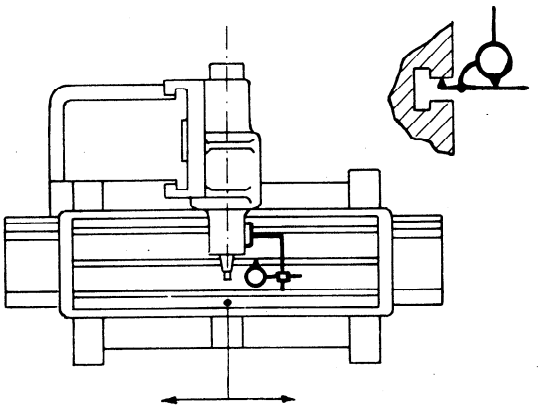
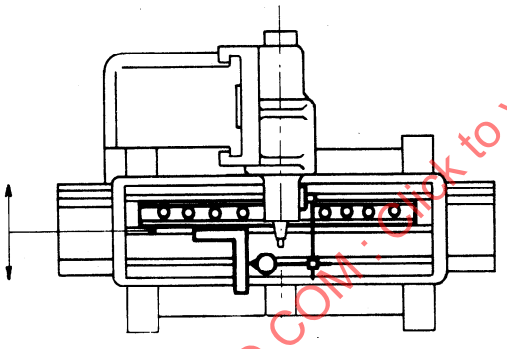
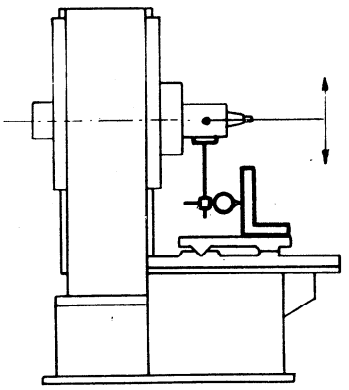
4.1 Geometrical tests

No.	Diagram	Object
G 0		Verification of levelling of slideways: *a)* Longitudinal verification: Straightness of slideways in the vertical plane.
		b) Transverse verification: Slideways should be in the same plane.
G 1		Verification of straightness of slideways in a horizontal plane.
		(These alternatives are for small machines where the table is not to be dismantled.) Verification of the straightness of the longitudinal movement of the table.

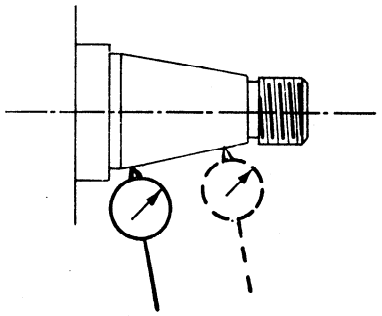
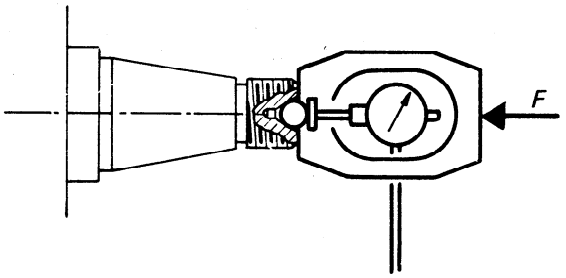
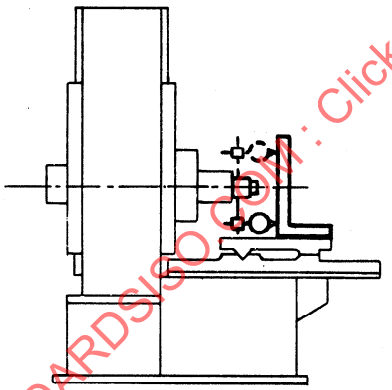
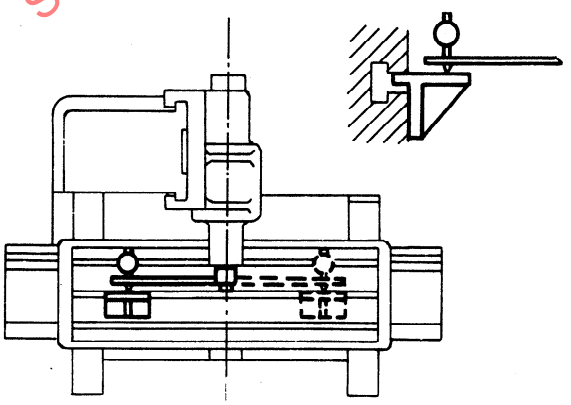
Permissible deviation		Measuring instruments	Observations and references in test code ISO/R 230
mm	in		
a) 0,02 up to 1 000 For each 1 000 mm increase in length, add 0,015 Maximum permissible deviation : 0,05	*a*) 0.000 8 up to 40 For each 40 in increase in length, add 0.000 6 Maximum permissible deviation : 0.002	Precision levels, optical or other methods	*a*) Clauses 3.11, 3.21, 5.212.21 and 5.212.22 Measurements should be made at a number of positions equally spaced along the length of the slideways. For machines standing on three support points or having a table travel less than 1 500 mm (60 in) the table need not be removed. In this case the level should be placed successively on the exposed portions of the slideways and on the table. The table should be in its central position.
a) Variation of level : 0,02/1 000	*b*) Variation of level : 0.000 8/40		*b*) Clause 5.412.7 A level should be placed transversely on the slideways, and measurements should be taken at a number of positions equally spaced along the length of the slideway. The variation of level measured at any position should not exceed the permissible deviation.
0,02 up to 1 000 For each 1 000 mm increase in length, add 0,02 Maximum permissible deviation : 0,05 Local tolerance : 0,01 over any measuring length of 300	0.000 8 up to 40 For each 40 in increase in length, add 0.000 8 Maximum permissible deviation : 0.002 Local tolerance : 0.000 4 over any measuring length of 12	Straightedge, support and dial gauge, or taut wire and microscope	Clause 5.232.1 The dial gauge should be fixed on a support A of a suitable form such that it can slide in the slideways with the stylus touching a straightedge laid parallel to the slideways.
0,01 up to 1 000 For each 1 000 mm increase in length, add 0,01 Maximum permissible deviation : 0,025	0.000 4 up to 40 For each 40 in increase in length, add 0.000 4 Maximum permissible deviation : 0.001		Clauses 5.232.1 or 5.212.3 — 5.232.2 In alternative 1), the dial gauge support should be placed on a fixed part of the machine, the stylus touching a straightedge laid parallel to the general direction of the longitudinal movement of the table.

No.	Diagram	Object
G 2		Verification of flatness of the table surface.
G 3	 Alternative 	Verification of parallelism of the table surface : *a*) to its longitudinal movement; *b*) to its transverse movement or to the transverse movement of the wheelhead.

Permissible deviation		Measuring instruments	Observations and references in test code ISO/R 230
mm	in		
0,01 up to 1 000 For each 1000 mm increase in length, add 0,01 Maximum permissible deviation : 0,04 Local tolerance : 0,005 over any measuring length of 300	0.000 4 up to 40 For each 40 in increase in length, add 0.000 4 Maximum permissible deviation : 0.001 6 Local tolerance : 0.000 2 over any measuring length of 12	Straightedge and slip gauges or precision level	Clauses 5.322 and 5.323 Table not locked and positioned at the centre of travel.
a) $0{,}010 \times \frac{L^*}{1\,000}$ Maximum permissible deviation : 0,030 Local tolerance : 0,003 over any measuring length of 300 *b)* $0{,}007 \times \frac{L^*}{1\,000}$ (this permissible deviation should be ⩾ 0,001)	*a)* $0.000\,4 \times \frac{L^*}{40}$ Maximum permissible deviation : 0.001 2 Local tolerance : 0.000 12 over any measuring length of 12 *b)* $0.000\,3 \times \frac{L^*}{40}$ (this permissible deviation should be ⩾ 0.000 04)	Dial gauge	Clause 5.422.21 1) Checking by direct contact with the table. 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. The stylus to be placed approximately in the wheel spindle axis. * L = measuring length
a) $0{,}007 \times \frac{L^*}{1\,000}$ Maximum permissible deviation : 0,020 *b)* $0{,}007 \times \frac{L^*}{1\,000}$ (this permissible deviation should be ⩾ 0,001)	*a)* $0.000\,3 \times \frac{L^*}{40}$ Maximum permissible deviation : 0.000 8 *b)* $0.000\,3 \times \frac{L^*}{40}$ (this permissible deviation should be ⩾ 0.000 04)	Dial gauge and precision straightedge	2) Checking with a straightedge. It is unnecessary to follow the test code ISO/R 230. The checking should be made on a straightedge laid parallel to the table surface and placed in the direction of the movement concerned. * L = measuring length

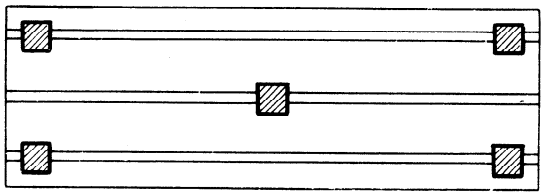
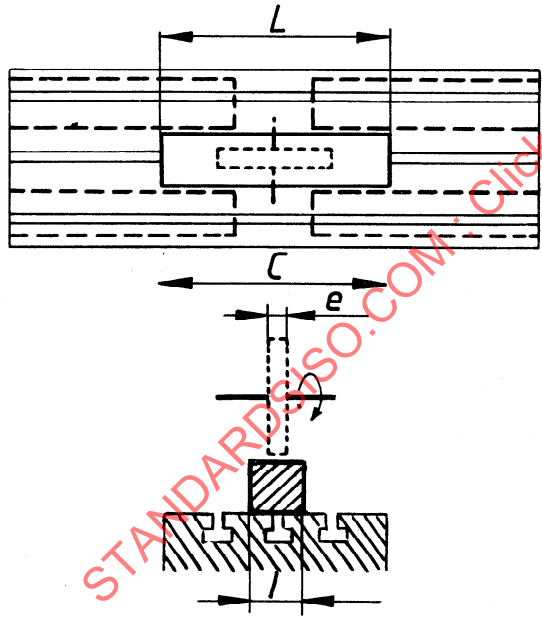
No.	Diagram	Object
G 4		Verification of parallelism of the median or reference T slot to the longitudinal movement of the table.
G 5		Verification of squareness of the longitudinal movement of the table to its transverse movement or to the wheelhead movement.
G 6		Verification of squareness and straightness of the vertical movement of the wheelhead to the table surface in a transverse vertical plane.

Permissible deviation		Measuring instruments	Observations and references in test code ISO/R 230
mm	in		
0,015 up to 1 000 For each 1 000 mm increase in length, add 0,01 Maximum permissible deviation : 0,05 Local tolerance : 0,008 over any measuring length of 300	0.000 6 up to 40 For each 40 in increase in length, add 0.000 4 Maximum permissible deviation : 0.002 Local tolerance : 0.000 3 over any measuring length of 12	Dial gauge	Clauses 5.422.1 and 5.422.21 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.
0,03/300	0.001 2/12	Straightedge, square and dial gauge	Clause 5.522.4 *a*) Place the straightedge parallel to the longitudinal movement of the table and then place the table in its central position. *b*) Place the square in contact with the straightedge. *c*) Check the transverse movement of the table or the wheelhead.
0,04/300	0.001 6/12	Dial gauge and square	Clause 5.522.2 Clamp the wheelhead if possible when taking measurements. If the spindle can be locked, the dial gauge can be mounted on it. If the spindle cannot be locked, the dial gauge should be placed on a fixed part of the wheelhead.

No.	Diagram	Object
G 7		Measurement of run-out of the wheel spindle nose.
G 8		Measurement of periodic axial slip of the wheel spindle.
G 9		Verification of parallelism of the axis of the wheel spindle to the table surface.
G 10		Verification of squareness of the axis of the wheel spindle to the median or reference T slot of the table.

Permissible deviation		Measuring instruments	Observations and references in test code ISO/R 230
mm	in		
0,01	0.000 4	Dial gauge	Clauses 5.612.1 and 5.612.2 The stylus of the dial gauge should be set normal to the surface which is to be checked. Checking should be carried out at each extremity of the taper. This is not stated in the test code ISO/R 230.
0,01	0.000 4	Dial gauge	Clauses 5.622.1 and 5.622.2 A force *F*, specified by the manufacturer of the machine, should be exerted co-axially with the spindle. The line of action of the stylus of the dial gauge should be co-axial with the spindle.
0,025/300	0.001/12*	Dial gauge and square	Clauses 5.512.1 and 5.512.42 Table in central position. Wheelhead clamped when taking measurements. * Distance between the two points touched.
0,015/300*	0.000 6/12*	Dial gauge and square	Clauses 5.512.1 and 5.512.42 Table in central position. Wheelhead clamped when taking measurements. * Distance between the two points touched.

4.2 Practical tests

No.	Diagram and sizes of test pieces	Nature of test and cutting conditions	Checks to be applied
P 1	 Number of test pieces should be five. Material from which the test pieces should be manufactured may be either : *a*) cast iron; *b*) steel. The test pieces should be of equal hardness and should be suitably fixed to the table. The dimensions of the functional surfaces of the test pieces should be as small as possible, for instance : 50 mm × 50 mm (2 in × 2 in) square or 50 mm (2 in) diameter.	Grinding of five cylindrical or rectangular test blocks which are the test pieces. The surface of the test blocks in contact with the table should be ground before carrying out the test. The test pieces should be positioned as follows : — one at the central point of the table; — one at each of the four corners of the table.	After grinding test pieces should have the same thicknesses.
P 2	 $I \geqslant 3\,e$ $\quad L \geqslant \frac{C}{2}$ e = width of grinding wheel I = width of test piece L = length of test piece C = length of table travel Material from which the test pieces should be manufactured may be either : *a*) cast iron; *b*) steel.	This practical test should be carried out with combination of the longitudinal and transverse movements which are particular to every machine. Grinding of a rectangular block. The test piece should be clamped to the table by mechanical means. The rigidity of the test piece must be such as to prevent the clamping causing any deformation of the test piece. For the first test, the test piece should be fixed at the central position on the table. For any additional tests, the test pieces may be fixed at any other position on the table. The reference surface in contact with the table should be ground before carrying out the test.	For any given position of the test piece on the table, the thickness of the test piece should be constant.