

BS ISO 1986-1:2014



BSI Standards Publication

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

Part 1: Machines with table length of up to 1 600 mm

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National foreword

This British Standard is the UK implementation of ISO 1986-1:2014. It supersedes BS ISO 1986-1:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MTE/1/2, Machine tools - Accuracy.

A list of organizations represented on this committee can be obtained on request to its secretary.

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2014-06-01

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

Part 1:

**Machines with table length of up to 1
600 mm**

*Conditions d'essai des machines à rectifier les surfaces planes, à
broche porte-meules à axe horizontal — Contrôle de l'exactitude —*

Partie 1: Machines avec une table jusqu'à 1 600 mm de long



Reference number
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Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Terminology and designation of axes	1
4 Preliminary remarks	2
4.1 Measurement units.....	2
4.2 Reference to ISO 230-1.....	3
4.3 Testing sequence.....	3
4.4 Tests to be performed.....	3
4.5 Measuring instruments.....	3
4.6 Minimum Tolerance.....	3
4.7 Machining tests.....	3
4.8 Diagrams.....	3
5 Geometric tests	4
5.1 Linear axes.....	4
5.2 Table.....	8
5.3 Wheel spindle.....	11
6 Machining tests	15
Annex A (informative) Equivalent terms in other languages	17
Bibliography	18

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 39, *Machine tools*, Subcommittee SC 2, *Test conditions for metal cutting machine tools*.

This second edition cancels and replaces the first edition (ISO 1986-1:2001), which has been technically revised.

ISO 1986 consists of the following parts, under the general title *Test conditions for surface grinding machines with horizontal grinding wheel spindle and reciprocating table — Testing of the accuracy*:

— *Part 1: Machines with a table length of up to 1 600 mm*

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

Part 1:

Machines with table length of up to 1 600 mm

1 Scope

This part of ISO 1986 specifies, with reference to ISO 230-1, both geometric and machining tests on general purpose and normal accuracy surface grinding machines with reciprocating table up to 1 600 mm table length and horizontal grinding wheel spindle. It also specifies the applicable tolerances corresponding to the above-mentioned tests.

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

This part of ISO 1986 deals only with the verification of the accuracy of the machine; it does not apply to the testing of the machine operation (vibrations, abnormal noises, stick-slip motion of components, etc.), nor to the machine characteristics (such as speeds, feeds, etc.), which should generally be checked before testing the accuracy.

This part of ISO 1986 provides the terminology used for the principal components of the machine and indicates the designation of the axes with reference to ISO 841.

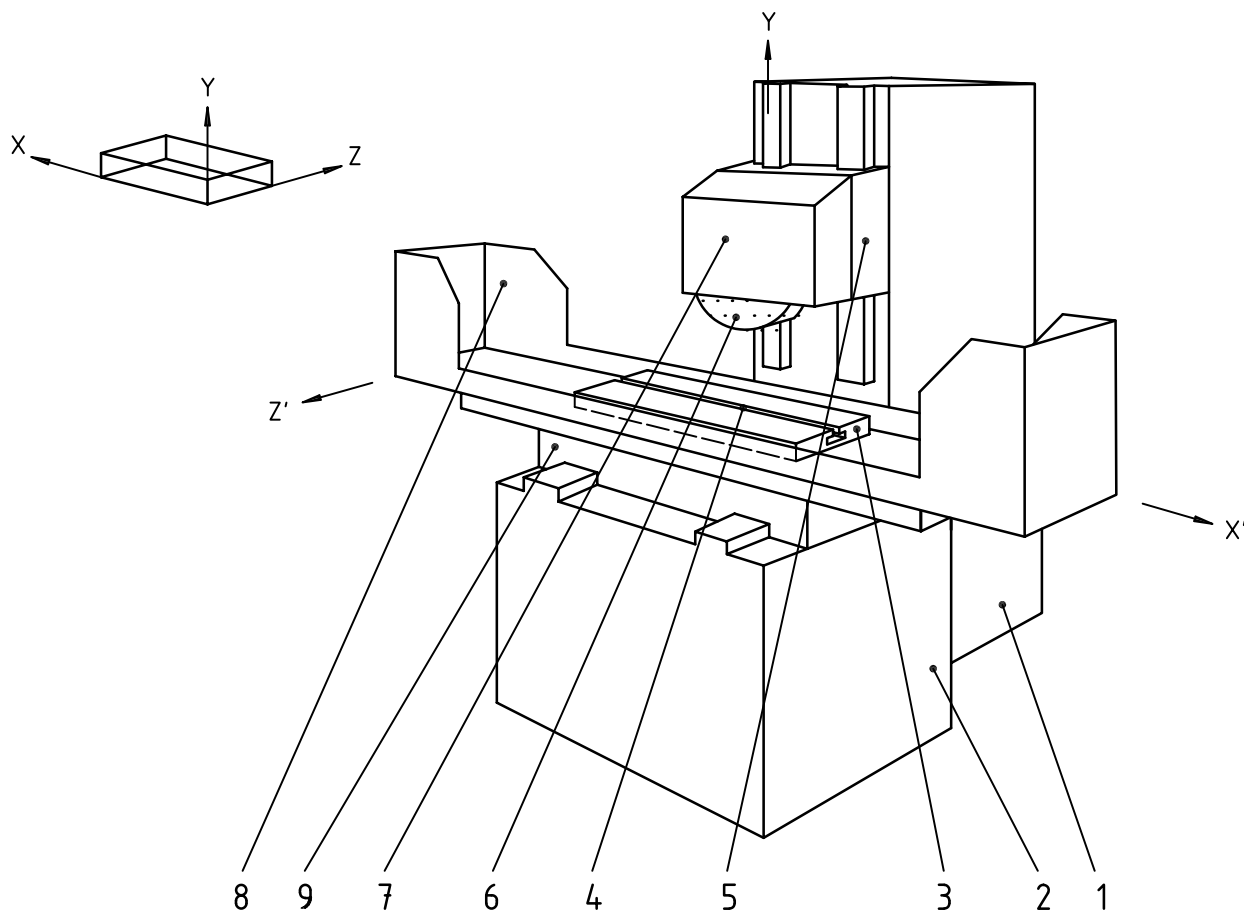
2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 230-1:2012, *Test code for machine tools — Part 1: Geometric accuracy of machines operating under no-load or quasi-static conditions*

3 Terminology and designation of axes

See [Figure 1](#) and [Table 1](#).



NOTE For the key, see [Table 1](#).

Figure 1 — Schematic of surface grinding machine with horizontal wheel spindle and reciprocating table

Table 1 — Terminology for surface grinding machines (Key for [Figure 1](#))

	English	French
1	Column	Montant
2	Bed	Banc
3	Table	Table
4	Reference T-slot	Rainure en T de positionnement
5	Wheelhead	Poupée porte-meule
6	Grinding wheel	Outil à rectifier
7	Wheel guard	Carter de protection
8	Splash guard	Protection
9	Saddle	Chariot transversal

4 Preliminary remarks

4.1 Measurement units

In this part of ISO 1986, all linear dimensions, deviations, and corresponding tolerances are expressed in millimetres. All angular dimensions are expressed in degrees. Angular deviations are, in principle,

expressed in ratios (e.g. 0,00x/1 000), but in some cases, microradians, or arcseconds can be used for clarification purposes. The following expression is used for conversion of the units of angular deviations and angular tolerances:

$$0,010/1\ 000 = 10\ \mu\text{rad} \approx 2''$$

4.2 Reference to ISO 230-1

To apply this part of ISO 1986, reference shall be made to ISO 230-1, especially for the installation of the machine before testing, warming up of the spindle, and other moving components, description of measuring methods, and recommended uncertainty of testing equipment.

In the “Observations” block of the tests described in [Clauses 5](#) and [6](#), the instructions are preceded by a reference to the corresponding Clause in ISO 230-1 in cases where the test concerned is in compliance with the specifications of that International Standard.

4.3 Testing sequence

The sequence in which the tests are presented in this part of ISO 1986 in no way defines the practical order of testing. In order to make the mounting of fixtures and machining easier, tests can be performed in any order.

4.4 Tests to be performed

When testing a machine, it is not always necessary or possible to carry out all the tests described in this part of ISO 1986. When the tests are required for acceptance purposes, it is up to the user to choose, in agreement with the supplier/manufacturer, those tests relating to the components and/or the properties of the machine which are of interest. These tests are to be clearly stated when ordering a machine. A mere reference to this part of ISO 1986 for the acceptance tests, without specifying the tests to be carried out, and without agreement on the relevant expenses, cannot be considered as binding for any contracting party.

4.5 Measuring instruments

The measuring instruments indicated in the tests described in [Clause 4](#) are examples only. Other instruments measuring the same quantities and having the same or smaller measurement uncertainty can be used.

4.6 Minimum Tolerance

When the tolerance for a geometric test is established for a measuring length different from that given in this part of ISO 1986 (see 4.1 of ISO 230-1:2012), it shall be taken into consideration that the minimum value of tolerance is 0,001 mm.

4.7 Machining tests

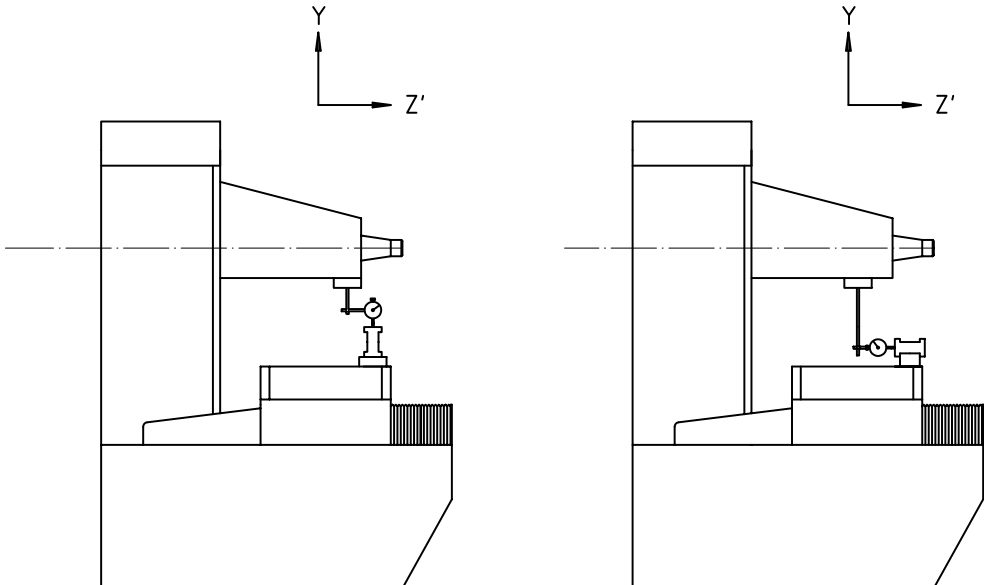
Machining tests shall be made under finishing conditions only, not with roughing cuts which are liable to generate appreciable cutting forces.

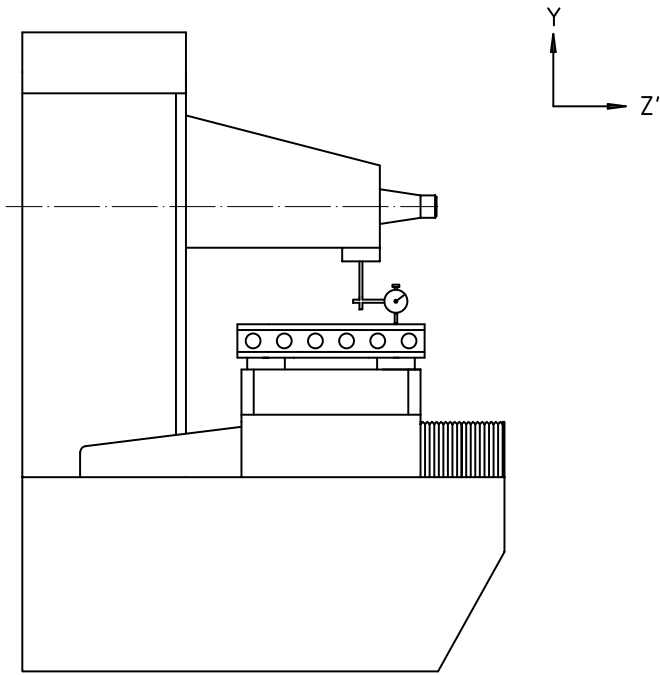
4.8 Diagrams

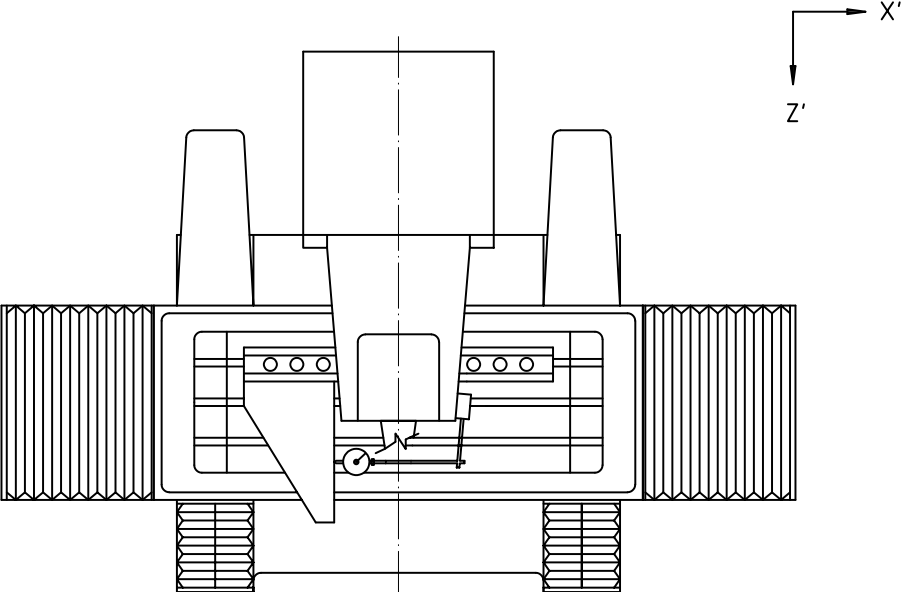
For reasons of simplicity, the diagrams in this part of ISO 1986 illustrate only one type of machine.

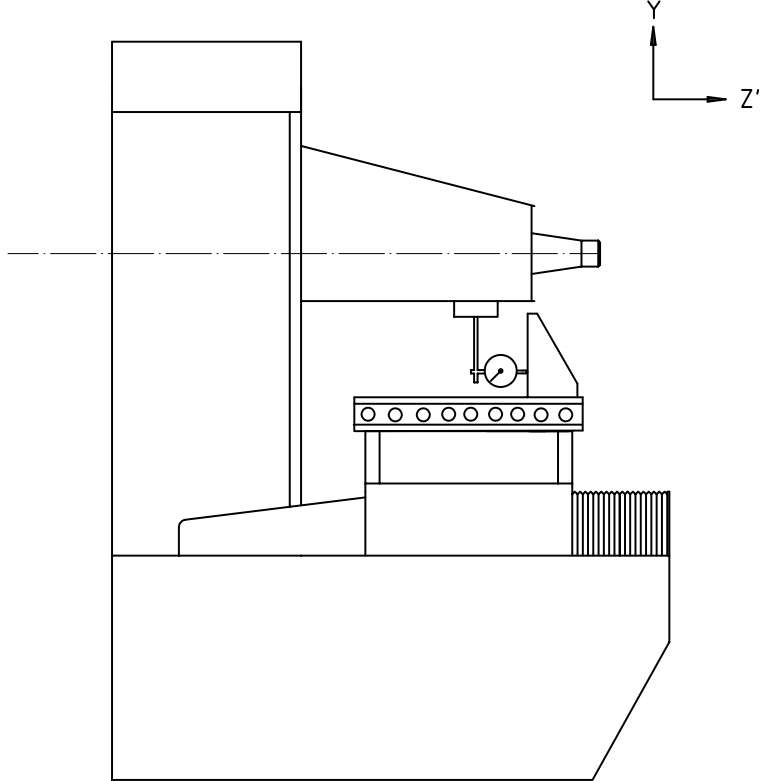
5 Geometric tests

5.1 Linear axes

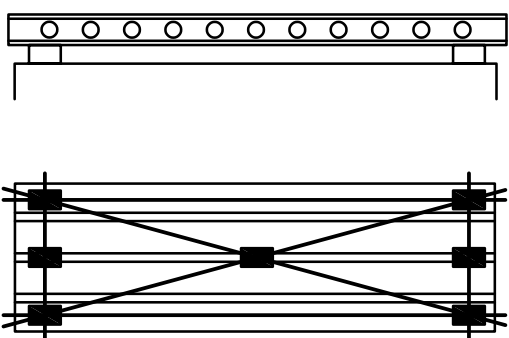
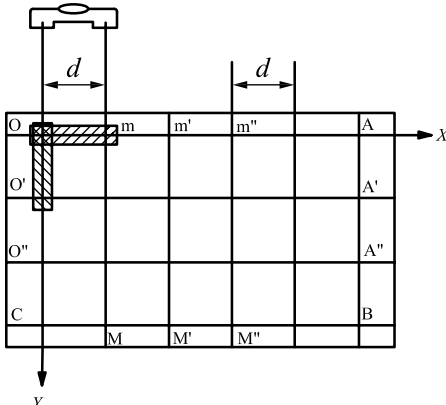
<p>Object</p> <p>Checking of straightness of the longitudinal (X-axis) movement of the table</p> <p>a) in the vertical XY-plane, and</p> <p>b) in the horizontal ZX-plane</p>	<p>G1</p>
<p>Diagram</p>  <p style="text-align: center;">a) b)</p>	
<p>Tolerance</p> <p>For a) and b): 0,010 for a measuring length up to 1 000 0,016 for a measuring length exceeding 1 000 Local tolerance: 0,005 for any measuring length of 300</p>	<p>Measured deviation</p>
<p>Measuring instruments</p> <p>Straightedge and dial gauge, alignment telescope, laser interferometer, or taut wire, and microscope [for b) only]</p>	
<p>Observations and references to ISO 230-1:2012, 3.4.8, 8.2.2.1, and 8.2.3</p> <p>Adjust the straightedge to obtain similar readings at each end of the measuring length. The dial gauge support shall be placed on a fixed part of the wheelhead, the stylus touching the straightedge.</p>	

Object	G2
Checking of the straightness of the transverse movement of the saddle or column or wheelhead (Z-axis) in the vertical YZ-plane	
<p>Diagram</p> 	
<p>Tolerance</p> <p>0,010 for a measuring length of up to 500</p> <p>0,015 for a measuring length exceeding 500</p> <p>Local tolerance: 0,005 over any measuring length of 300</p>	Measured deviation
<p>Measuring instruments</p> <p>Straightedge and dial gauge, alignment telescope, or laser interferometer</p>	
<p>Observations and references to ISO 230-1:2012, 3.4.8, 8.2.2.1, and 8.2.3</p> <p>Adjust the straightedge to obtain similar readings at each end of the measuring length.</p> <p>The dial gauge support shall be placed on a fixed part of the wheelhead, the stylus touching a straightedge.</p>	

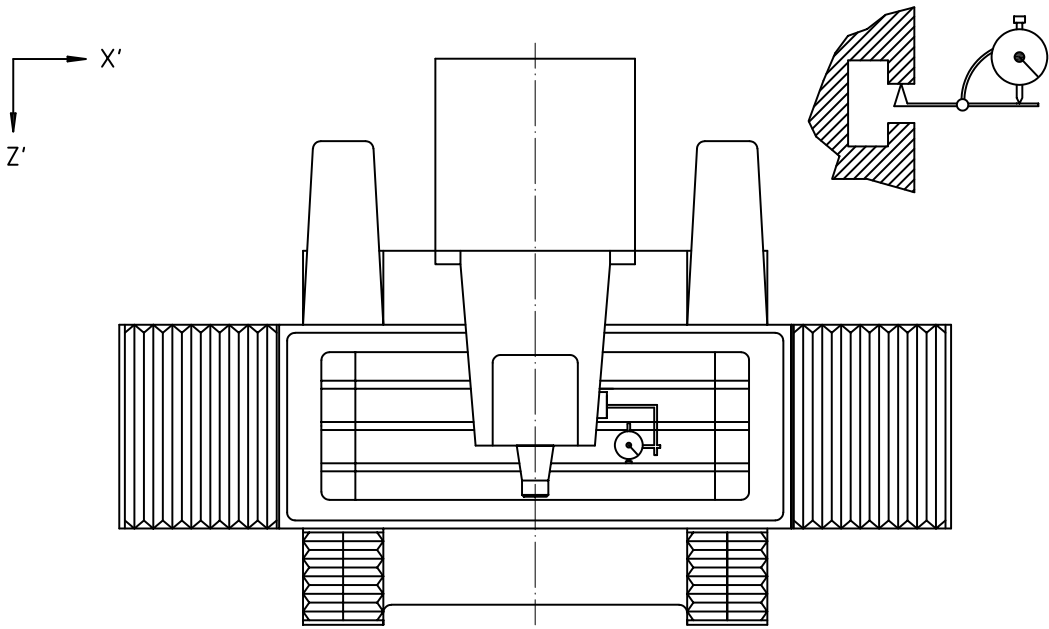
Object	G3
Checking of squareness between the longitudinal (X-axis) movement of the table and the transverse movement (Z-axis) of the saddle or column or wheelhead.	
Diagram 	
Tolerance 0,1/1 000 (0,03/300)	Measured deviation
Measuring instruments Straightedge, square, and dial gauge	
Observations and references to ISO 230-1:2012, 10.3.2 The dial gauge shall be placed on a fixed part of the wheelhead. Place a straightedge parallel to the longitudinal movement of the table and then place the table in its central position. Place a square in contact with the straightedge. Check the transverse movement of the saddle or column or wheelhead.	

Object	G4
Checking of the squareness between the vertical movement of the wheelhead (Y-axis) and the transverse movement of saddle or column or wheelhead (Z-axis).	
Diagram 	
Tolerance 0,133/1 000 (0,04/300)	Measured deviation
Measuring instruments Dial gauge and square, straightedge, and gauge blocks	
Observations and references to ISO 230-1:2012, 10.3.2 The dial gauge shall be placed on a fixed part of the wheelhead. Place a straightedge parallel to the transverse movement of the table and then place the table in its central position. Place a square in contact with the straightedge. Check the vertical movement of the wheelhead.	

5.2 Table

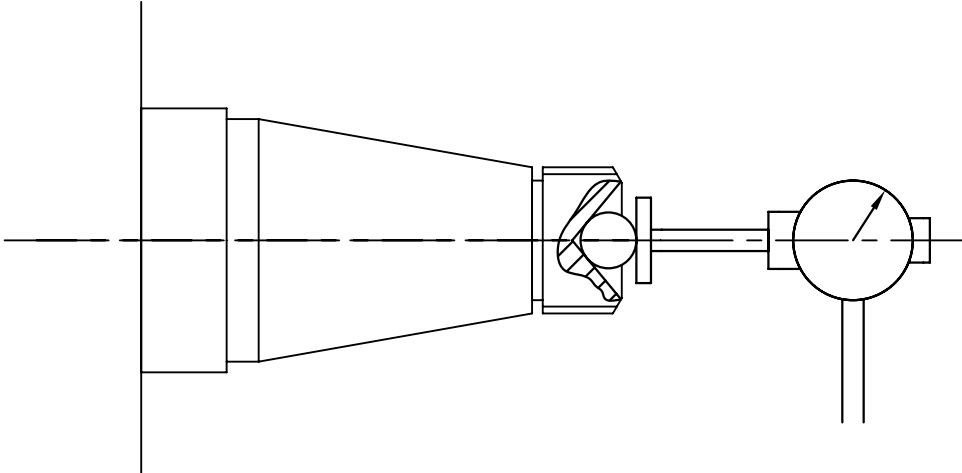
Object		G5
Checking of flatness of the work holding surface ^a		
Diagram		
		
a) Flatness measurement with straightedge	b) Flatness measurement with precision level	
Tolerance		Measured deviation
0,01 for a measuring length up to 1 000		Table length =
0,02 for a measuring length exceeding 1 000		
Local tolerance: 0,005 over any measuring length of 300		
Measuring instruments		
Straightedge and gauge blocks, or precision level		
Observations and references to ISO 230-1:2012, 12.2.3 and 12.2.4		
Horizontal movements (X and Z) shall be in mid-position.		
^a The work holding surface can belong to the table or to the magnetic chuck, if it is mounted on the table.		

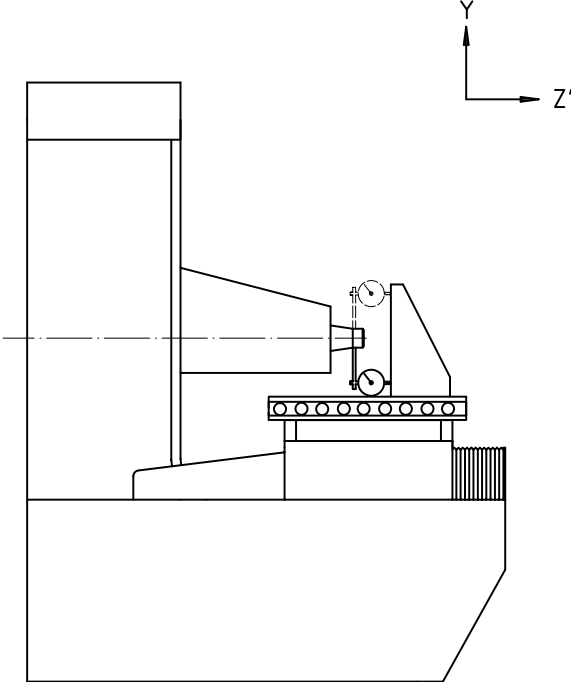
Object	G6
<p>Checking of parallelism between the work holding surface^a and</p> <p>a) the longitudinal movement of the table (X-axis);</p> <p>b) the transverse movement of the saddle or column or wheelhead (Z-axis).</p>	
<p>Diagram</p> <p style="text-align: center;">a) b)</p>	
<p>Tolerance</p> <p>a) $0,012 \times L/1\ 000$</p> <p>Local tolerance: 0,005 over any measuring length of 300</p> <p>b) $0,002+0,01 \times L/1\ 000$</p> <p>where L is the measuring length</p>	<p>Measured deviation</p> <p>a)</p> <p>b)</p>
<p>Measuring instruments</p> <p>Dial gauge</p>	
<p>Observations and references to ISO 230-1:2012, 12.3.2.5</p> <p>The dial gauge shall be placed on a fixed part of the wheelhead.</p> <p>The stylus should be placed approximately in the vertical plane centring the wheel spindle axis.</p> <p>If direct contact of the table with the dial gauge affects the measurement due to T-slots or chip pockets, gauge blocks can be used between the dial gauge and table surface in the measuring points.</p>	
<p>^a The work holding surface can belong to the table or to the magnetic chuck, if it is mounted on the table.</p>	

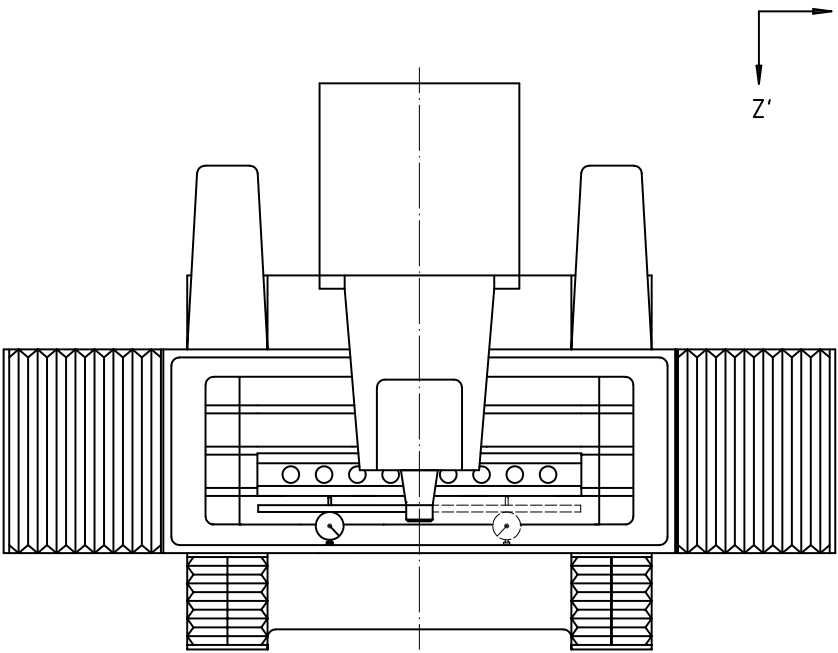
Object	G7
Checking of parallelism between the median or reference T-slot of the table (or the reference edge of the magnetic chuck if it is mounted on the table) and the longitudinal movement of the table (X-axis)	
Diagram 	
Tolerance 0,015 for a measuring length up to 1 000 0,020 for a measuring length exceeding 1 000 Local tolerance: 0,008 over any measuring length of 300	Measured deviation
Measuring instruments Dial gauge	
Observations and references to ISO 230-1:2012, 12.3.2.5 The dial gauge shall be placed on a fixed part of the wheelhead.	

5.3 Wheel spindle

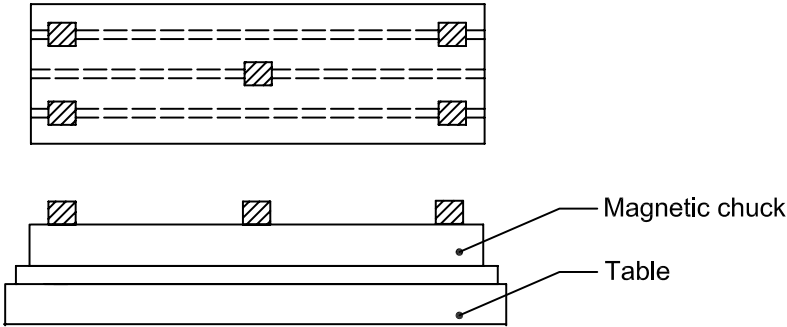
Object		G8
Measurement of runout of the wheel-spindle nose		
Diagram		
Tolerance		Measured deviation
0,005		
Measuring instruments		
Dial gauge		
Observations and references to ISO 230-1:2012, 12.5.2		
The stylus of the dial gauge shall be set normal to the surface which is to be checked at the smaller end of the taper.		

Object	G9
Measurement of axial error motion of the wheel spindle	
Diagram 	
Tolerance 0,005	Measured deviation
Measuring instruments Dial gauge	
Observations and references to ISO 230-1:2012, 9.1 The line of action of the stylus of the dial gauge shall be coaxial with the spindle.	

Object	G10
Checking of parallelism between the wheel spindle axis and the transverse movement of the saddle or column or wheel head (Z-axis)	
Diagram 	
Tolerance 0,025/300 ^a	Measured deviation
Measuring instruments Dial gauge and square, straightedge, and gauge blocks.	
Observations and references to ISO 230-1:2012, 10.1.4 Place a straightedge parallel to the transverse movement of the table and then place the table in its central position. Place a square in contact with the straightedge. Check the wheel-spindle axis by rotating the dial gauge against the square.	
^a Distance between the two measuring points touched.	

Object	G11
Checking of squareness between the wheel-spindle axis and the longitudinal movement of the table (X-axis)	
Diagram 	
Tolerance 0,015/300 ^a	Measured deviation
Measuring instruments Dial gauge and special arm and straightedge	
Observations and references to ISO 230-1:2012, 10.3.3 Place a straightedge horizontally at the centre of the table, parallel to the X-axis movement of the table. Set transverse and longitudinal movements (X and Z) in mid-position. Check the wheel-spindle axis by rotating the dial gauge against the straightedge.	
^a Distance between the two measuring points touched.	

6 Machining tests

Object	M1
Surface grinding five test pieces to equal height	
Diagram 	
Tolerance 0,005 for a distance between test pieces of 300 (For distance between the test pieces <300: the tolerance shall be proportional to the distance, but not below 0,001.) Maximum tolerance: 0,025	Measured deviation
Measuring instruments Precision dial gauge	
Observations and references to ISO 230-1:2012, 6.1, 6.2.2, B.1, and B.2 The surface of the test pieces in contact with the work holding surface shall be ground before carrying out the test. The work holding surface can belong to the table or to the magnetic chuck, if it is mounted on the table. The test pieces shall be suitably fixed to the table and positioned as follows: — one at the central point of the table, or — one at each of the four corners of the table. Material from which the test pieces should be manufactured can be either a) cast iron, or b) steel. The test pieces should be of equal hardness. The dimensions of the functional surfaces of the test pieces should be as small as practicable, for instance, 50 mm × 50 mm square or 50 mm diameter.	

Object	M2
Grinding of a single rectangular test piece of constant height with a combination of longitudinal and transverse movements	
Diagram	
<p>e = width of the grinding wheel l = width of the test piece L = length of the test piece C = length of table travel</p>	
<p>Material from which the test pieces should be manufactured can be either</p> <p>a) cast iron, or</p> <p>b) steel.</p>	
Checks to be applied	
For any given position of the test piece on the work holding surface, the thickness of the test piece should be constant.	
<p>Tolerance</p> <p>0,005 for a measuring length of 300</p> <p>Maximum tolerance: 0,020</p>	<p>Measured deviation</p>
Measuring instruments	
Precision dial gauge, comparator	
Observations and references to ISO 230-1:2012, 6.1, 6.2.2, B.1, and B.2	
The surface of the test pieces in contact with the work holding surface shall be ground before carrying out the test.	
The work holding surface can belong to the table or to the magnetic chuck, if it is mounted on the table.	
The rigidity of the test piece shall be such as to prevent the clamping causing deformation of the test piece.	
For the first test, the test piece shall be fixed at the central position on the work-holding surface.	
For any additional test, the test pieces can be fixed at any other position on the work-holding surface.	

Annex A (informative)

Equivalent terms in other languages

[Table A.1](#) gives equivalent terms in German and Italian published under the responsibility of the member bodies for Germany (DIN) and Italy (UNI).

Table A.1 — Equivalent terms (see [Figure 1](#))

	German	Italian
1	Ständer	Montante
2	Bett	Banco
3	Tisch	Tavola
4	Richtnut	Scanalatura di riferimento
5	Schleifspindelstock	Testa porta-mola
6	Schleifwerkzeug	Mola
7	Schutzhaube	Riparo mola
8	Fangschutz	Riparo para-spruzzi
9	Schlitten	Sella

Bibliography

- [1] ISO 841:2001, *Industrial automation systems and integration — Numerical control of machines — Coordinate system and motion nomenclature*

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