INTERNATIONAL STANDARD

ISO 1986-1

Second edition
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
ISO 1986-1:2014(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

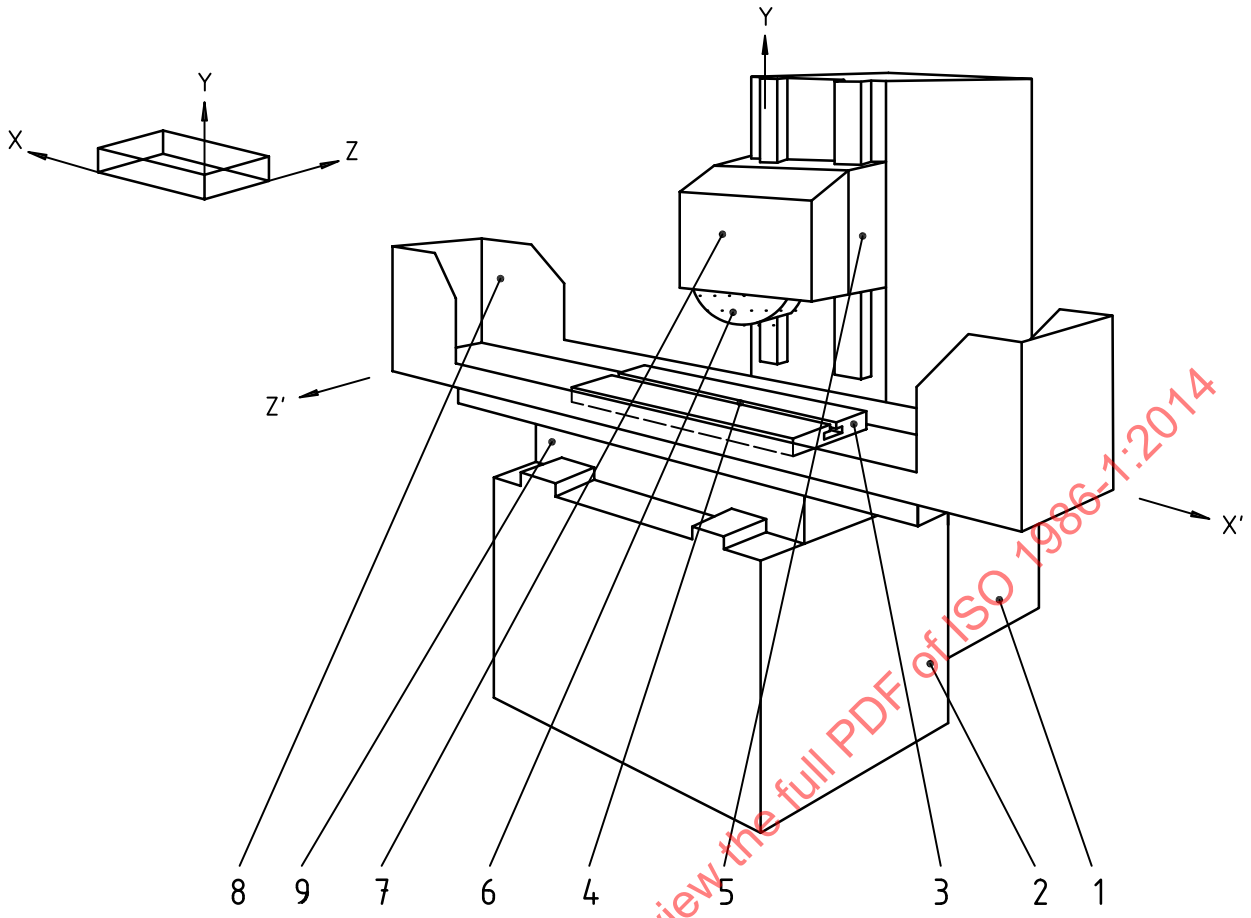
2 Normative references

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 µrad ≈ 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

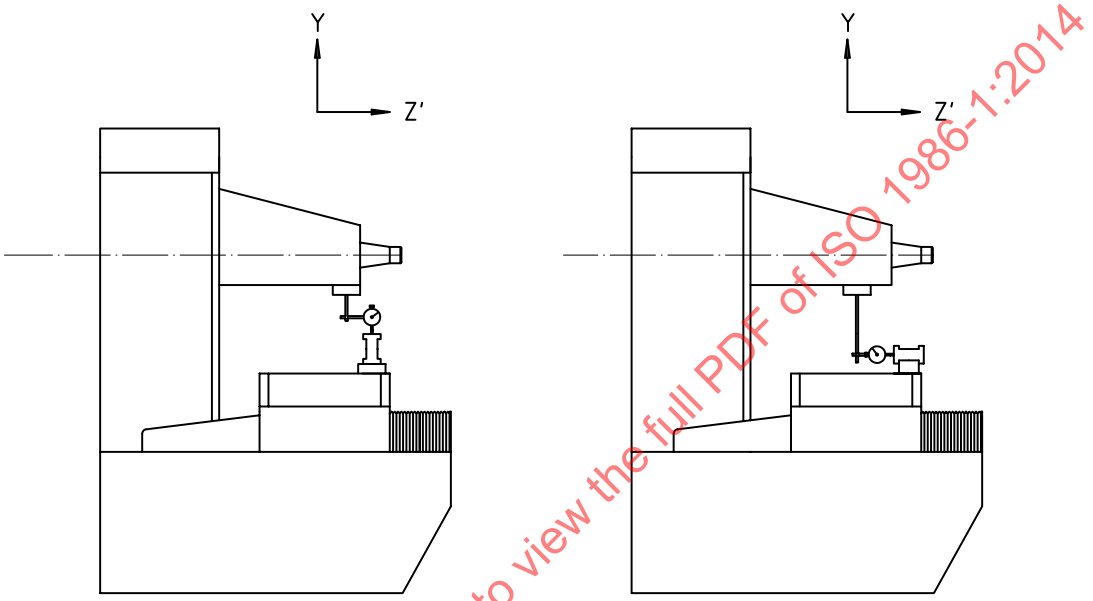
For reasons of simplicity, the diagrams in this part of ISO 1986 illustrate only one type of machine.

5 Geometric tests

5.1 Linear axes

Object	**G1**
Checking of straightness of the longitudinal (X-axis) movement of the table a) in the vertical XY-plane, and b) in the horizontal ZX-plane	

Diagram



a) b)

Tolerance	**Measured deviation**
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	

Measuring instruments

Straightedge and dial gauge, alignment telescope, laser interferometer, or taut wire, and microscope [for b) only]

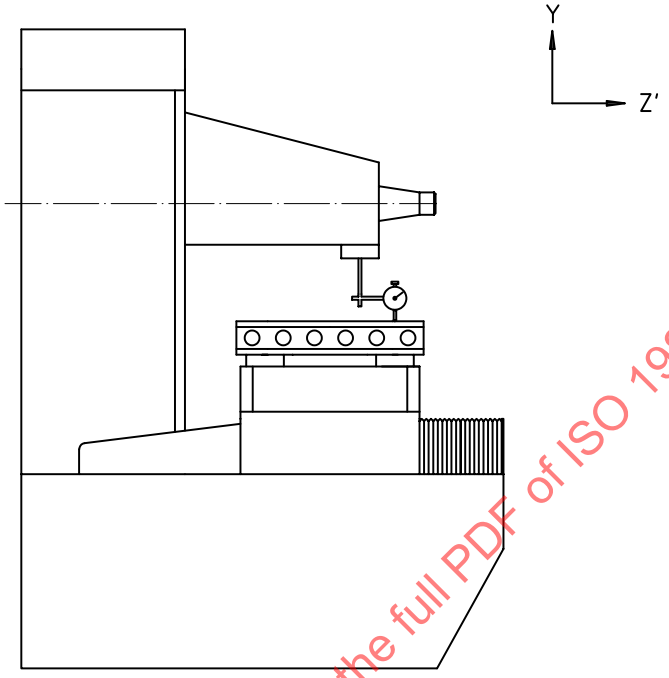
Observations and references to ISO 230-1:2012, 3.4.8, 8.2.2.1, and 8.2.3

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.

Object	**G2**
Checking of the straightness of the transverse movement of the saddle or column or wheelhead (Z-axis) in the vertical YZ-plane	

Diagram



Tolerance	**Measured deviation**
0,010 for a measuring length of up to 500 0,015 for a measuring length exceeding 500 Local tolerance: 0,005 over any measuring length of 300	

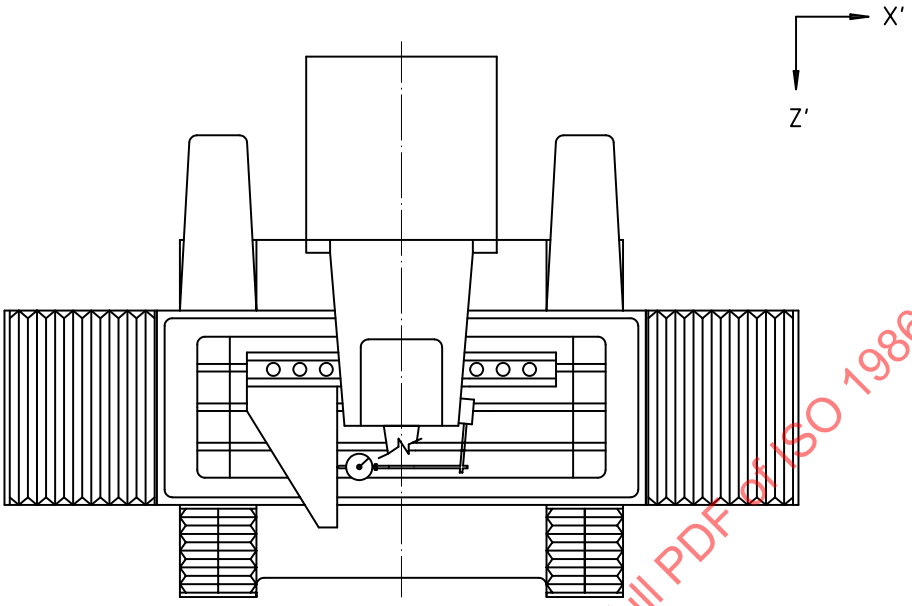
Measuring instruments

Straightedge and dial gauge, alignment telescope, or laser interferometer

Observations and references to ISO 230-1:2012, 3.4.8, 8.2.2.1, and 8.2.3

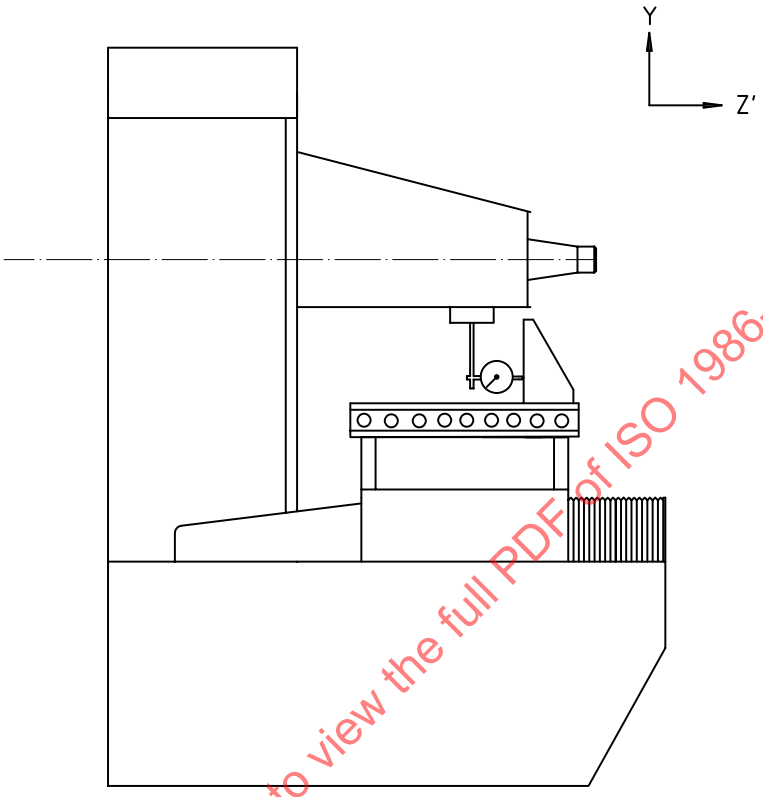
Adjust the straightedge to obtain similar readings at each end of the measuring length.

The dial gauge support shall be placed on a fixed part of the wheelhead, the stylus touching a straightedge.

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	**Measured deviation**
0,133/1 000 (0,04/300)	

Measuring instruments

Dial gauge and square, straightedge, and gauge blocks

Observations and references to ISO 230-1:2012, 10.3.2

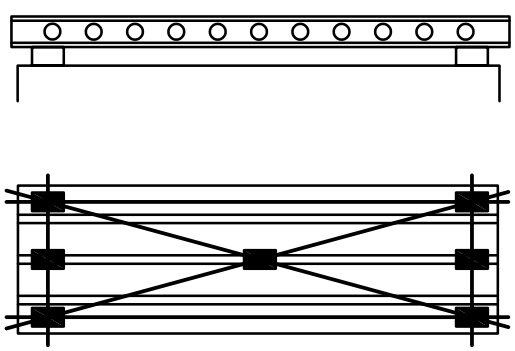
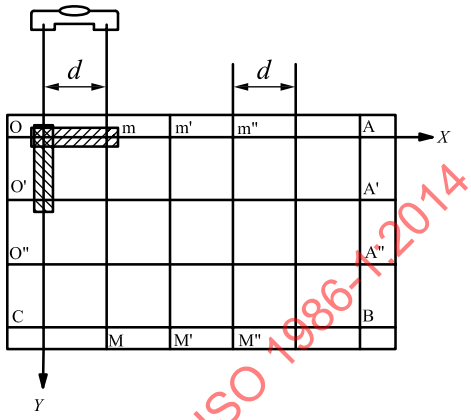
The dial gauge shall be placed on a fixed part of the wheelhead.

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.

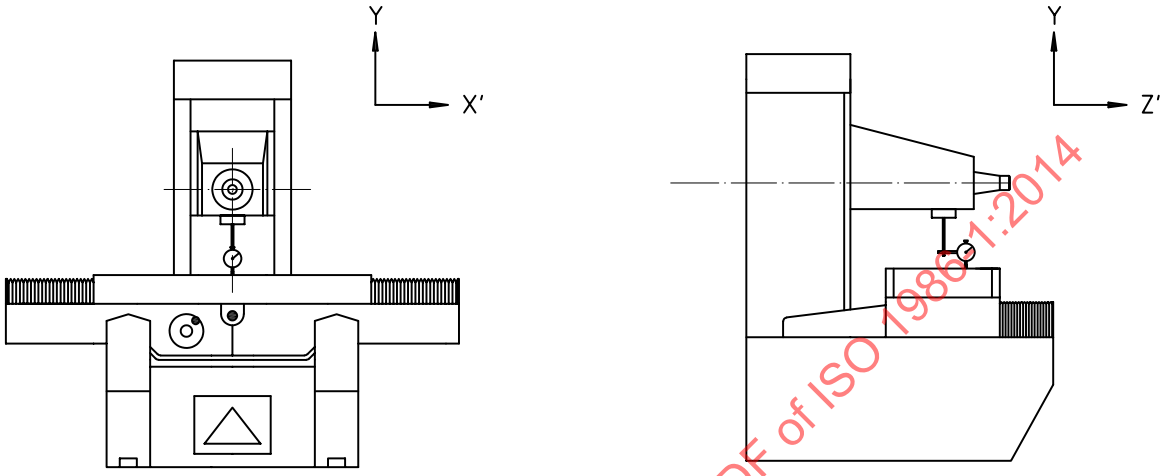
Check the vertical movement of the wheelhead.

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 0,01 for a measuring length up to 1 000 0,02 for a measuring length exceeding 1 000 Local tolerance: 0,005 over any measuring length of 300	**Measured deviation** Table length = ...
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**
Checking of parallelism between the work holding surface[a] and a) the longitudinal movement of the table (X-axis); b) the transverse movement of the saddle or column or wheelhead (Z-axis).	

Diagram



a) b)

Tolerance	**Measured deviation**
a) 0,012 × L/1 000 Local tolerance: 0,005 over any measuring length of 300 b) 0,002+0,01 × L/1 000 where L is the measuring length	a) b)

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.

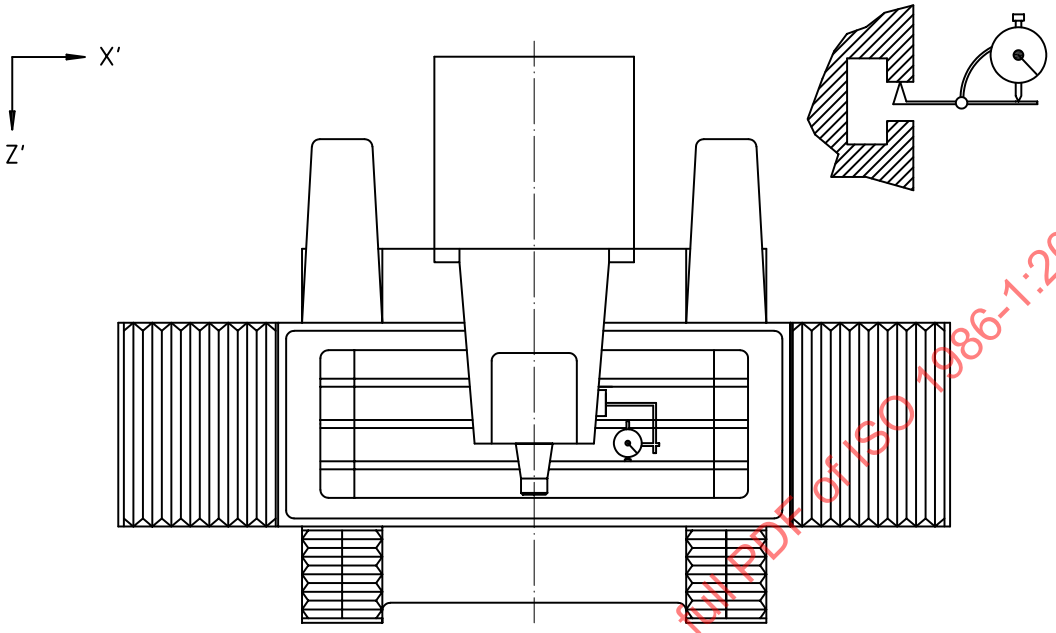
The stylus should be placed approximately in the vertical plane centring the wheel spindle axis.

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.

[a] The work holding surface can belong to the table or to the magnetic chuck, if it is mounted on the table.

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	**Measured deviation**
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	

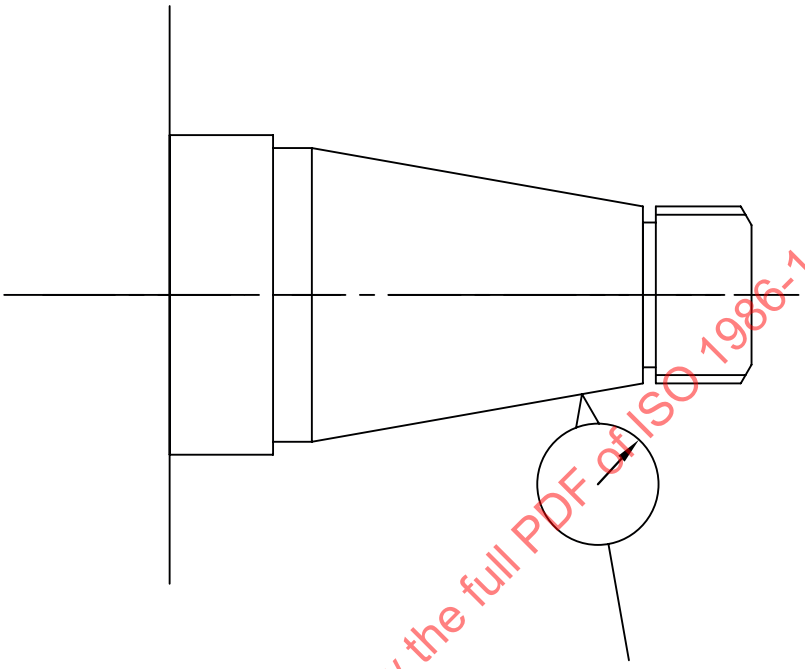
Measuring instruments

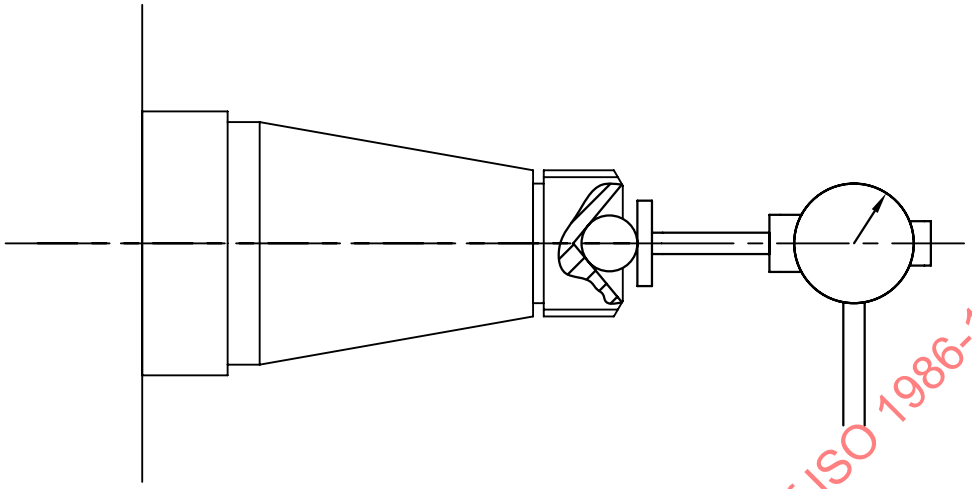
Dial gauge

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.

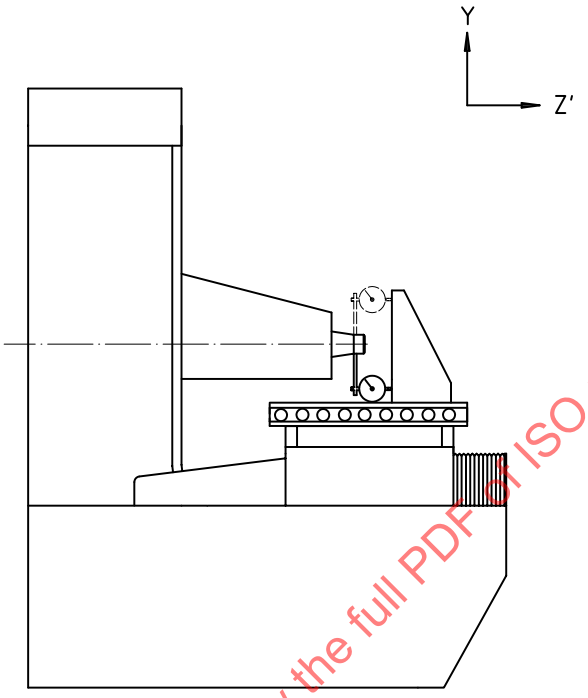
5.3 Wheel spindle

Object	**G8**
Measurement of runout of the wheel-spindle nose	
Diagram 	
Tolerance 0,005	**Measured deviation**
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	**Measured deviation**
0,025/300[a]	

Measuring instruments

Dial gauge and square, straightedge, and gauge blocks.

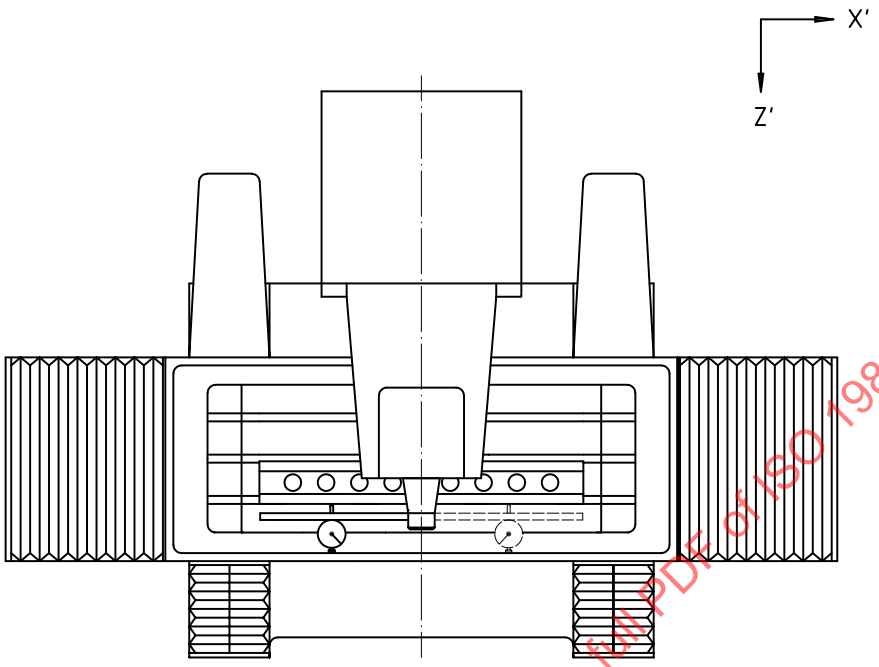
Observations and references to ISO 230-1:2012, 10.1.4

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.

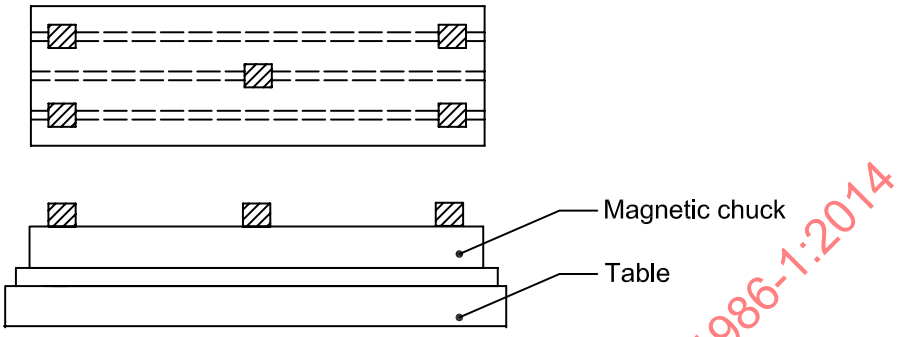
[a] Distance between the two measuring points touched.

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	**Measured deviation**
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	

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.