



**International  
Standard**

**ISO 2773**

**Test conditions for pillar type  
vertical drilling machines — Testing  
of accuracy**

*Conditions d'essais des machines à percer verticales à colonne —  
Contrôle de l'exactitude*

**First edition  
2024-02**

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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. 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 document 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](http://www.iso.org/directives)).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 2, *Test conditions for metal cutting machine tools*.

This first edition of ISO 2773 cancels and replaces ISO 2773-1:1973 and ISO 2773-2:1973.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The purpose of this document is to standardize methods of testing the accuracy of pillar type vertical drilling machines including geometrical tests.

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# Test conditions for pillar type vertical drilling machines — Testing of accuracy

## 1 Scope

This document specifies, with reference to ISO 230-1, geometrical tests on general purpose and normal accuracy pillar type vertical drilling machines. This document also specifies the applicable tolerances corresponding to the above-mentioned tests.

This document covers only the verification of accuracy of the machine.

This document does not apply to the testing of the machine operation (vibrations, abnormal noises, stick-slip motion of components, etc.) or to machine characteristics (such as speeds and feeds), which are generally checked before testing of machine accuracy.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 230-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **manual drilling machine**

drilling machine where the axial motion of the cutting tool is controlled through the actuation of a handwheel or lever

Note 1 to entry: The handwheel or lever can include powered axial feed or powered unprogrammed positioning of spindle or workpiece.

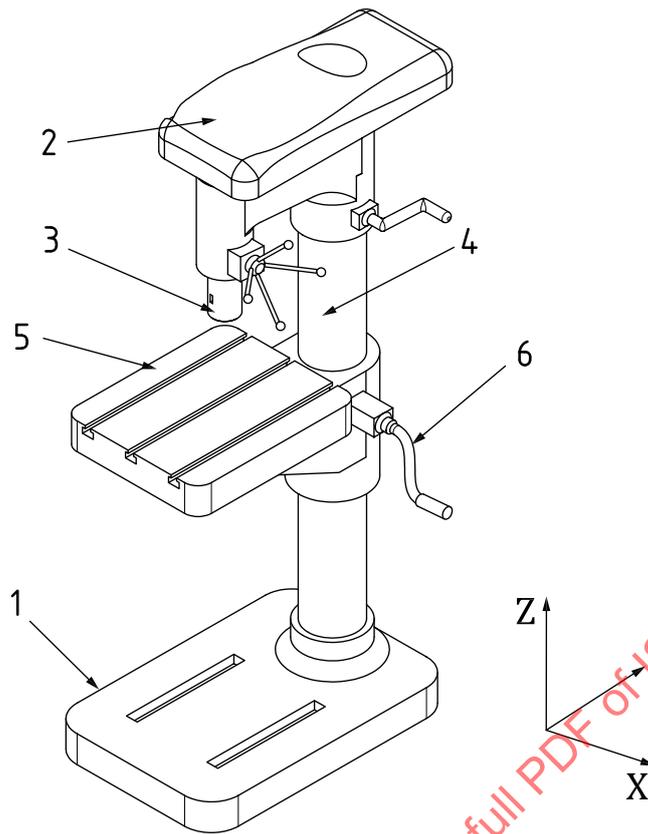
### 3.2

#### **pillar type vertical manual drilling machine**

*manual drilling machine* (3.1) in which the drilling head and working table are mounted in adjustable positions on a vertical column

## 4 Terminology, designation of axes and machine configurations

For the nomenclature and terminology of a pillar type vertical manual drilling machine, see [Figure 1](#).



**Key**

- 1 base
- 2 spindle head (Z2 axis)
- 3 spindle/quill (Z axis)
- 4 column
- 5 table (W-axis)
- 6 table height adjuster

NOTE For terms in French, Italian and Persian, see [Table A.1](#).

**Figure 1 — Example of a pillar type vertical manual drilling machine**

## 5 Preliminary remarks

### 5.1 Measurement units

In this document, all linear dimensions, deviations and corresponding tolerances are expressed in millimetres (mm); angular dimensions are expressed in degrees (°), and angular deviations and the corresponding tolerances are expressed in ratios. In some cases, microradians (μrad) or arcseconds (") may be used for clarification purposes. The equivalence of the following expressions should always be kept in mind:

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

### 5.2 Reference to ISO 230-1, ISO 230-7 and ISO/TR 230-11

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

Where the test concerned is in compliance with the specifications of ISO 230-1, a reference to the corresponding subclause of ISO 230-1 is shown before the instructions in the "Observations" block of the tests described in [Clause 6](#).

### 5.3 Testing sequence

The sequence in which the tests are presented in this document in no way defines the practical order of testing. In order to make the mounting of instruments or gauging easier, tests may be performed in any order.

### 5.4 Test to be performed

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

### 5.5 Measuring instruments

Measuring instruments indicated in the tests described below are only examples. Other instruments capable of measuring the same quantities and having the same, or a smaller, measurement uncertainty may be used. Reference shall be made to ISO 230-1:2012, Clause 5, which indicates the relationship between measurement uncertainties and the tolerances.

### 5.6 Minimum tolerance

When establishing the tolerance for a measuring length different from that given in this document (see ISO 230-1:2012, 4.1), it shall be taken into consideration that the minimum value of tolerance is 0,010.

### 5.7 Levelling

Prior to conducting tests on a pillar type vertical drilling machine, the machine should be levelled according to the recommendations of the manufacturer/supplier (see ISO 230-1:2012, 6.1.2).

6 Test conditions and permissible deviations

6.1 Table

<p><b>Object</b> Checking of flatness of the table surface (and of the base surface if it is machined).</p>	<p><b>G1</b></p>
<p><b>Diagram</b></p>	
<p><b>Tolerance</b> 0,030 for a measuring area of up to 300 × 300 Total tolerance: 0,050 (flat or concave)</p>	<p><b>Measured error</b></p>
<p><b>Measuring instruments</b> Precision level or straightedge and gauge blocks.</p>	
<p><b>Observations and references to ISO 230-1:2012, 12.2.3 and 12.2.4</b></p>	

<b>Object</b>	<b>G2</b>
Measurement of face run out of the rotating table (for machines having this feature).	
<b>Diagram</b>	
<b>Key</b> R radial measuring distance	
<b>Tolerance</b> 0,075 for $R = 150$	<b>Measured error</b> for $R =$
<b>Measuring instruments</b> Gauge block and dial gauge.	
<b>Observations and references to ISO 230-1:2012, 12.5.2 and ISO 230-7:2015, 3.4.5</b> Set the dial gauge base on the spindle head and lock the head to have the best possible stiffness. Place a gauge block on the table, against the dial gauge at the maximum achievable radius ( $R$ ) of the face and record the dial gauge reading. For a complete table rotation, at least eight measurements should be taken at roughly equal angular intervals. The measured error is the total difference between the dial gauge's minimum and maximum readings.	

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6.2 Spindle (quill)

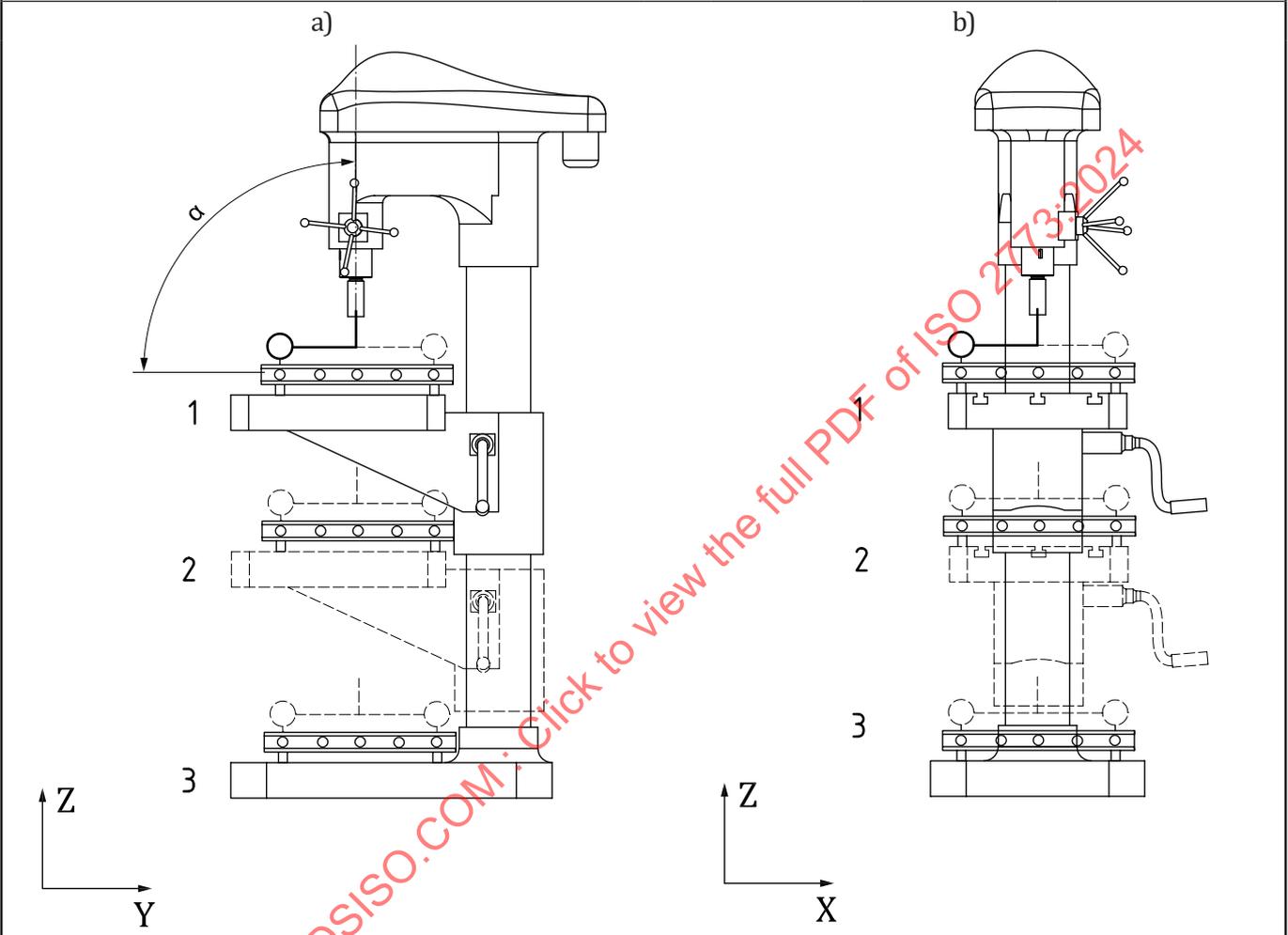
<b>Object</b>		<b>G3</b>
Measurement of run-out of the internal taper of the spindle: a) near the spindle nose; b) at a distance of 250 from the spindle nose.		
<b>Diagram</b>		
<p>The diagram illustrates a spindle assembly. A vertical spindle is shown with a dial gauge attached to its side. Two measurement points are indicated: 'a)' is located near the top of the spindle, and 'b)' is located further down. A vertical dimension line labeled 'l' indicates the distance from the spindle nose to point 'b)'. To the right of the spindle, a coordinate system is shown with a vertical arrow labeled 'Z' and a horizontal arrow labeled 'X'.</p>		
<b>Key</b>		
l distance from the spindle nose		
<b>Tolerance</b>		<b>Measured error</b>
a) 0,020		a)
b) 0,035		b)
<b>Measuring instruments</b>		
Dial gauge and test mandrel.		
<b>Observations and references to ISO 230-1:2012, 12.5.3 and ISO/TR 230-11:2018</b>		
For details of the test, reference should be made to ISO 230-1:2012, 12.5.3.		

**Object** **G4**

Checking of squareness of the spindle axis to the table surface and to the base surface (if it is machined):

- a) in the plane of symmetry of the machine (YZ plane);
- b) in the plane perpendicular to the plane of symmetry of the machine (ZX plane).

**Diagram**



<b>Key</b>	
1 upper position	3 base surface
2 lower position	$\alpha$ angle between the table and Z-axis

Tolerance	Measured error
for positions 1), 2) and 3)	
a) Distance between the two points touched: 0,060/300 with $\alpha \leq 90^\circ$ (since cutting forces will increase $\alpha$ )	a)
b) Distance between the two points touched: 0,060/300	b)

**Measuring instruments**  
Dial gauge and straightedge.

**Observations and references to ISO 230-1:2012, 12.4.1 and 12.4.8**  
Squareness checking should be carried out first with the table in the upper position 1 and then in the lower position 2 and base surface 3 by varying the length of support arm of the dial gauge. The quill and table are locked.

<p><b>Object</b></p>	<p>G5</p>
<p>Checking of squareness of the quill motion (Z-axis), if available, to the table surface:  a) in the plane of symmetry of the machine (YZ plane);  b) in the plane perpendicular to the plane of symmetry of the machine (ZX plane).</p>	
<p><b>Diagram</b></p>	
<p><b>Key</b>  <math>\alpha</math> angle between the table surface and the quill axis (Z-axis)</p>	
<p><b>Tolerance</b>  a) 0,100/300 with <math>\alpha \leq 90^\circ</math> (since cutting forces will increase <math>\alpha</math>)  b) 0,100/300</p>	<p><b>Measured error</b>  a)  b)</p>
<p><b>Measuring instruments</b>  Dial gauge and cylindrical square.</p>	
<p><b>Observations and references to ISO 230-1:2012, 12.4.5</b>  The table is locked in mid-position.  The spindle head (for machines having elevating spindle head) is locked.</p>	