



**International  
Standard**

**ISO 8636-1**

**Machine tools — Test conditions for  
bridge-type milling machines —**

**Part 1:  
Testing of the accuracy of fixed  
bridge (portal-type) machines**

*Machines-outils — Conditions d'essai des machines à fraiser à  
portique —*

*Partie 1: Contrôle de l'exactitude des machines à portique fixe*

**Third edition  
2026-05**

# Sample Document

get full document from [standards.iteh.ai](https://standards.iteh.ai)



## **COPYRIGHT PROTECTED DOCUMENT**

© ISO 2026

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

	Page
Foreword.....	iv
<b>1 Scope.....</b>	<b>1</b>
<b>2 Normative references.....</b>	<b>1</b>
<b>3 Terms and definitions.....</b>	<b>1</b>
<b>4 Classification and description of fixed bridge-type milling machines.....</b>	<b>2</b>
4.1 Classification.....	2
4.2 Descriptions of principal components.....	2
4.2.1 General.....	2
4.2.2 Bed and table.....	2
4.2.3 Column, cross-rail and bridge or tie-piece.....	3
4.2.4 Spindle head(s).....	4
4.2.5 Cutting motion.....	4
4.2.6 Feed motion.....	4
4.3 Designation of axes.....	4
<b>5 Preliminary remarks.....</b>	<b>5</b>
5.1 Measuring units.....	5
5.2 Reference to ISO 230-1, ISO 230-2 and ISO 230-7.....	5
5.3 Machine levelling.....	6
5.4 Temperature conditions.....	6
5.5 Testing sequence.....	6
5.6 Tests to be performed.....	6
5.7 Measuring instruments.....	6
5.8 Software compensation.....	6
5.9 Minimum tolerance.....	7
5.10 Positioning tests.....	7
5.11 Diagrams.....	7
<b>6 Geometric tests for axes of linear motion.....</b>	<b>8</b>
<b>7 Geometric tests for the table.....</b>	<b>23</b>
<b>8 Geometric tests for the vertical spindle head.....</b>	<b>26</b>
<b>9 Geometric tests for the horizontal spindle head.....</b>	<b>29</b>
<b>10 Accuracy and repeatability of positioning of linear axes.....</b>	<b>33</b>
<b>Annex A (informative) Geometric accuracy of axes of rotation.....</b>	<b>39</b>
<b>Annex B (informative) Measurement of straightness error motion of large moving tables.....</b>	<b>41</b>
<b>Annex C (informative) Terms in other languages for <a href="#">Figure 1</a>.....</b>	<b>43</b>
<b>Bibliography.....</b>	<b>44</b>

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

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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

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 third edition cancels and replaces the second edition (ISO 8636-1:2000), which has been technically revised.

The main changes are as follows:

- references in Observations have been updated to ISO 230-1:2012, ISO 230-2:2014, and ISO 230-7:2015,
- the former [Clause 3](#) “Definitions and descriptions” has been renamed “Terms and definitions”,
- the content of the original [subclause 3.2](#) has been moved to a new [Clause 4](#) “Classification and description of fixed bridge-type milling machines”, which now also includes the content of original [Clause 4](#) “Terminology and designation of axes” which has been revised to better represent current technology,
- preliminary remarks subclauses have been revised to be consistent with the latest revisions of machine-tool specific standards,
- tolerances for tests related to long axes (with travel lengths up to 10 000) have been introduced,
- tests for straightness and angular errors of Z-axis motion have been added,
- tests for straightness and angular errors of cross-rail W-axis motion have been added,
- tests for parallelism of the V-axis motion to Y-axis motion have been added,
- tests for geometric accuracy of axis of rotation have been added in [Annex A](#),
- a new [Annex B](#) has been added to provide additional information related to tests for straightness of the X'-axis motion in the vertical ZX plane,  $E_{ZX}$ , to account for non-rigid body behaviour of large tables,
- the test for table flatness (formerly G9) has been deleted because the table surface is not normally used as a reference for the orientation of the workpiece, and, for tests made during the working life of the

## ISO 8636-1:2026(en)

machine tool, the surface might no longer be suitable for accurate measurements on these large machine tools,

- the tests for tilting spindle heads (formerly G15 and P7) have been deleted as such heads are not in the scope of this document,
- the machining tests have been excluded considering that such tests are typically the object of agreement between manufacturer/supplier and user, (possibly) including tests that are specified in ISO 10791-7.

A list of all parts in the ISO 8636 series can be found on the ISO website.

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).

# Sample Document

get full document from [standards.iteh.ai](http://standards.iteh.ai)

# Sample Document

get full document from [standards.iteh.ai](https://standards.iteh.ai)

# Machine tools — Test conditions for bridge-type milling machines —

## Part 1: Testing of the accuracy of fixed bridge (portal-type) machines

### 1 Scope

This document specifies, with reference to ISO 230-1 and ISO 230-2, geometric tests and tests for checking the accuracy and repeatability of positioning of numerically controlled axes for general purpose, normal accuracy, bridge-type milling machines with a fixed bridge (portal type). This document also specifies the applicable tolerances corresponding to the above-mentioned tests.

This document is applicable to machines with moving tables and fixed double columns. It does not include single-column (open sided) machines and those with fixed tables and moving columns.

This document deals only with the verification of the accuracy of the machine. It does not apply to the testing of the machine operation (vibration, abnormal noise, stick-slip motion of components, etc.) nor to machine characteristics (such as speeds, feeds, etc.), which are generally checked before testing the accuracy.

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

### 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*

ISO 230-2:2014, *Test code for machine tools — Part 2: Determination of accuracy and repeatability of positioning of numerically controlled axes*

ISO 230-7:2015, *Test code for machine tools — Part 7: Geometric accuracy of axes of rotation*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 230-1, ISO 230-2, ISO 230-7 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 milling operation

machining operation to generate surfaces of various geometries in which the principal cutting motion is the rotation of a cutting tool with multiple cutting edges against the non-rotating workpiece and where the cutting energy is brought by the cutting tool rotation

Note 1 to entry: Milling operations mostly involve face milling or end milling. The tools are mounted either in the boring spindle taper or, as for face milling cutters, on the tool-holding spindle nose.

[SOURCE: ISO 3070-2:2016, 3.2]

### 3.2 boring operation

operation which consists of machining the diameters of cylindrical, conical, blind or through holes, to the required size

### 3.3 drilling and tapping operation

operation which consist of drilling and tapping blind or through holes

### 3.4 fixed bridge-type (portal-type) milling machine

double-column machine with one or more vertical spindle heads mounted on the cross-rail, above a table which has a longitudinal traverse (X'-axis) only

Note 1 to entry: Additional horizontal spindle heads can be mounted on the columns. The horizontal spindle axes can have a tilting capability. However, such spindle heads are beyond the scope of this document.

## 4 Classification and description of fixed bridge-type milling machines

### 4.1 Classification

These machine tools are classified into two types, depending upon their construction:

- bridge-type milling machines with cross-rail movable along Z(W-) axis and a bridge or tie-piece (see [Figure 1](#) Key 10) between the columns;
- bridge-type milling machines with a fixed height cross-rail which can replace the bridge or tie-piece.

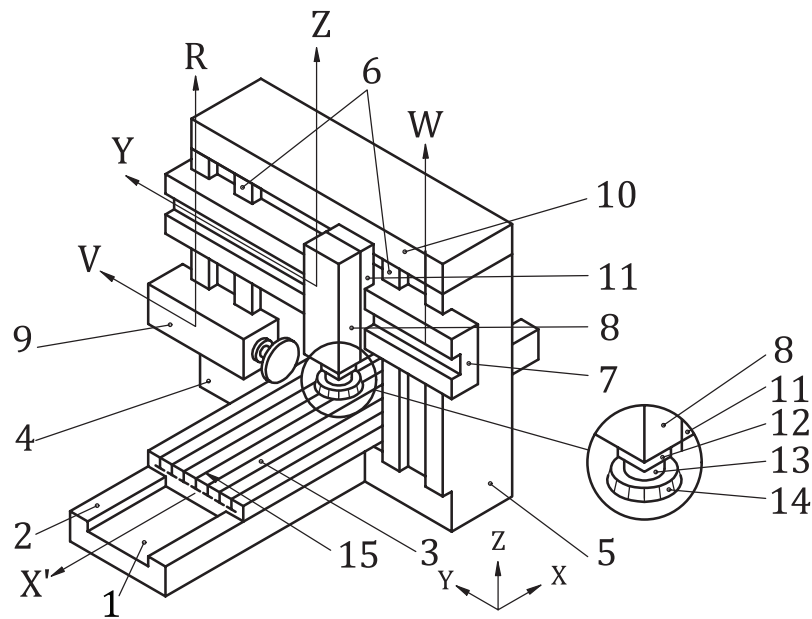
### 4.2 Descriptions of principal components

#### 4.2.1 General

The principal components of these machine tools are described in [4.2.2](#) through [4.2.6](#).

#### 4.2.2 Bed and table

The bed (see [Figure 1](#) Key 1) is the fixed base of the machine which can be constructed of several parts. It supports the table (see [Figure 1](#) Key 3) which moves parallel to the major axis of the bed.



**Key**

- 1 bed
- 2 bed slideways
- 3 table
- 4 left-hand column
- 5 right-hand column
- 6 slideways of right-hand and left-hand columns
- 7 cross-rail (movable or fixed)
- 8 vertical spindle head
- 9 horizontal spindle head
- 10 tie-piece
- 11 vertical spindle head saddle
- 12 quill or ram
- 13 tool-holding spindle
- 14 tool (milling cutter)
- 15 reference T-slot
- R vertical motion of the horizontal spindle head (R-axis)
- V horizontal motion of the horizontal spindle head (V-axis)
- W movable cross-rail vertical motion (W-axis)
- X' X'-axis
- Y Y-axis
- Z Z-axis

NOTE For terms in French, German, Italian, Japanese and Persian, see [Annex C](#).

**Figure 1 — Fixed bridge-type (portal-type) milling machine with variable height cross-rail**

**4.2.3 Column, cross-rail and bridge or tie-piece**

In [Figure 1](#), the columns (see [Figure 1](#) Keys 4 and 5) provide the vertical frame of the machine and are fixed on either side of the bed.

The columns can be fitted with vertical slideways (see [Figure 1](#) Key 6) to accommodate horizontal spindle head (see [Figure 1](#) Key 9) with other horizontal spindle axis.

The tie-piece (see [Figure 1](#) Key 10) is a fixed piece connecting both columns at, or near, the top.

The cross-rail (see [Figure 1](#) Key 7) has its major axis parallel to the table plane and is fitted with slideways on which one or more vertical spindle heads (see [Figure 1](#) Key 8) can move.

The variable height cross-rail, where available, can be moved up and down the vertical slideways (see [Figure 1](#) Key 6) on the columns.

In the case of machines with a fixed-height cross-rail, the latter is also fastened to the columns and can replace the tie-piece.

#### 4.2.4 Spindle head(s)

These heads include the spindle and drive mechanism and the means for their mounting on the cross-rail or column. In some cases, the tool-holding spindle (see [Figure 1](#) Key 13) can be mounted in a ram or quill (see [Figure 1](#) Key 12) with a feed motion for drilling, tapping, boring or milling operations.

#### 4.2.5 Cutting motion

Cutting motion is provided by the spindles and drive mechanisms of the spindle heads.

#### 4.2.6 Feed motion

The following feed motions can be provided with a constant or variable feed speed:

- horizontal motion of the table;
- horizontal motion of the spindle heads on the cross-rail or vertical and horizontal motions of the horizontal heads;
- vertical motion of spindle rams or quills (if any).

NOTE 1 In general, rapid traverse is available in addition to feed motion.

NOTE 2 The vertical motion of the cross-rail (if any) is usually a motion between stationary positions.

### 4.3 Designation of axes

See [Figures 2](#) to [4](#) for the designation of axes for different machine tools configurations.

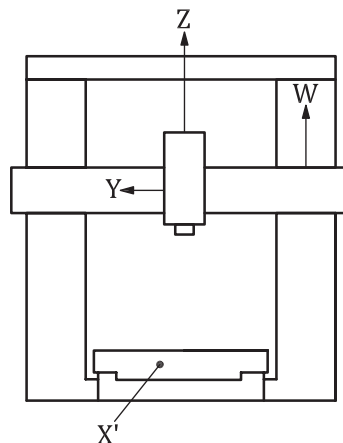
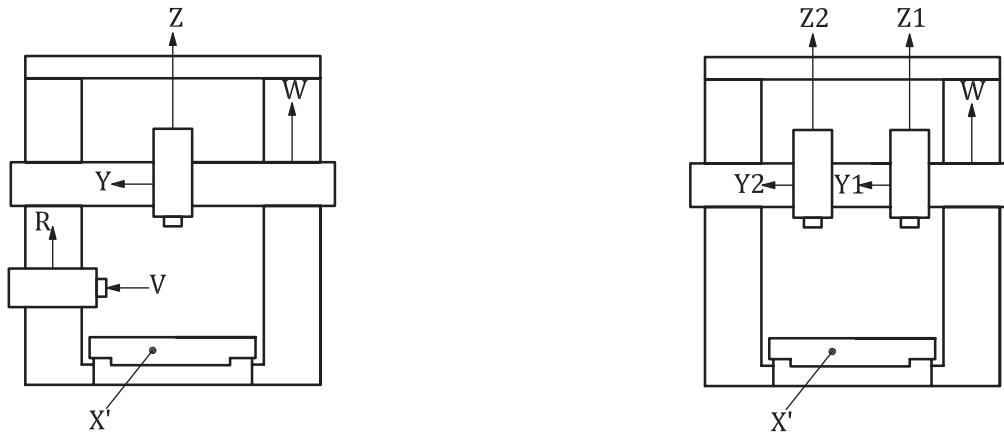


Figure 2 — Portal type machine tool with one spindle head



a) One vertical spindle head placed on the cross-rail and one horizontal spindle head placed on the left-hand column

b) Two vertical spindle heads on the cross-rail

Figure 3 — Portal type machine tools with two spindle heads

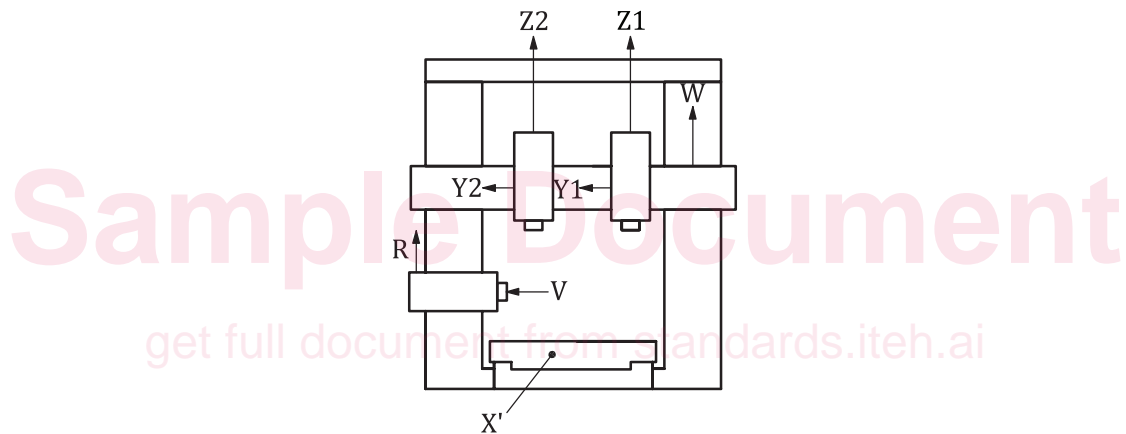


Figure 4 — Portal type machine tool with three spindle heads

## 5 Preliminary remarks

### 5.1 Measuring units

In this document, all linear dimensions, deviations, errors and corresponding tolerances are expressed in millimetres; angular dimensions are expressed in degrees, and angular errors and the corresponding tolerances are primarily expressed in ratios (e.g. 0,010/1 000), but in some cases, microradians ( $\mu\text{rad}$ ) or arcseconds ( $''$ ) are used for clarification purposes. [Formula \(1\)](#) should be used for the conversion of the units of angular errors or tolerances:

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

### 5.2 Reference to ISO 230-1, ISO 230-2 and ISO 230-7

To apply this document, reference shall be made to ISO 230-1 and ISO 230-7 when required, especially for the installation of the machine before testing, warming up of the spindle(s) and other moving components, description of measuring methods and recommended accuracy of testing equipment.

In the “Observations” box of the tests described in [Clauses 6](#) to [10](#), the instructions are preceded by a reference to the corresponding clause(s) in ISO 230-1, ISO 230-2 or ISO 230-7 in cases where the test concerned is in conformity with the specifications of one of those parts of the ISO 230 series.

### 5.3 Machine levelling

Prior to conducting tests on a machine tool, the machine tool should be levelled according to the recommendations of the manufacturer/supplier (see ISO 230-1:2012, 6.1).

### 5.4 Temperature conditions

The temperature conditions throughout the tests shall be specified by agreement between the manufacturer/supplier and user.

### 5.5 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.

### 5.6 Tests to be performed

When testing a machine, it is not always necessary nor 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 manufacturer/supplier, those tests relating to the components and/or the properties of the machine which are of interest. ISO 230-1:2012, Annex A provides valuable information about selection of primary and secondary axes and associated tests. These tests are to be clearly stated when ordering a machine. Simple reference to this document 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.

### 5.7 Measuring instruments

The measuring instruments indicated in the tests described in [Clauses 6](#) to [10](#) are examples only. Other instruments measuring the same quantities and having the same, or a smaller, measurement uncertainty can be used. Reference shall be made to ISO 230-1:2012, Clause 5, which indicates the relationship between measurement uncertainties and the tolerances.

When a “dial gauge” is referred to, it can mean not only dial test indicators (DTI), but any type of linear displacement sensor such as analogue or digital dial gauges, linear variable differential transformer (LVDTs), linear scale displacement gauges, or non-contact sensors, when applicable to the test concerned.

Similarly, when a “straightedge” is referred to, it can mean any type of straightness reference artefact, such as a granite or ceramic or steel or cast-iron straightedge, one arm of a square, one generating line on a cylindrical square, any straight path on a reference cube, or a special, dedicated artefact manufactured to fit in the T-slots or other references.

In the same way, when a “square” is mentioned, it can mean any type of squareness reference artefact, such as a granite or ceramic or steel or cast-iron square, a cylindrical square, a reference cube, or, again, a special, dedicated artefact.

When a “precision level” is referred to, it can mean any type of level such as bubble tube, digital and analogue electronic levels.

Valuable information on measuring instruments is available in ISO/TR 230-11.

### 5.8 Software compensation

When built-in software facilities are available for compensating geometric, positioning, contouring and thermal deviations, their use during these tests should be based on agreement between manufacturer/

supplier and user, with due consideration to the machine tool intended use, e.g. if the intended use of the machine tool is with or without software compensation for geometric errors. When the software compensation is used, this shall be stated in the test report. It shall be noted that when software compensation is used, some machine tool axes cannot be locked for test purposes.

Valuable information on numerical compensation of geometric errors is given in ISO/TR 16907.

### 5.9 Minimum tolerance

By mutual agreement, manufacturer/supplier and user can establish the tolerance for a measuring length different from that given in the tests described in [Clauses 6](#) to [10](#). However, it should be considered that the recommended minimum value of tolerance is 0,005 mm, unless otherwise specified.

In establishing the minimum tolerance, measurement uncertainty associated with the test and the recommended instrument, shall be taken into account, see [5.7](#).

### 5.10 Positioning tests

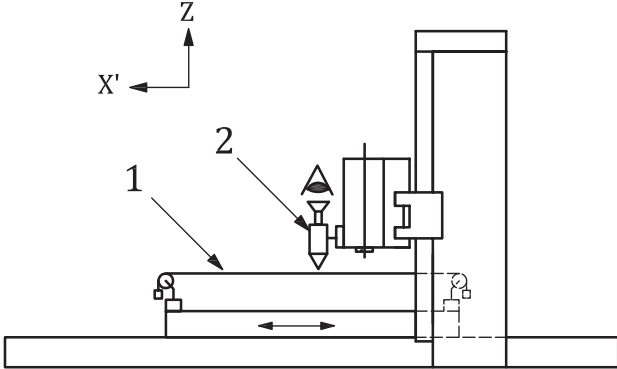
Positioning tests for numerically controlled machines shall refer to ISO 230-2. Tolerances in this document are given only for some parameters. The presentation of the test results shall be in accordance with ISO 230-2.

### 5.11 Diagrams

For reasons of simplicity, the diagrams in [Clauses 6](#) to [10](#) and in [Annex A](#), illustrate only one type of machine.

Where applicable, the diagram box provides, for each test a), b) and c) identified in the object box, a schematic representation of a possible test setup, including the identification of the relevant coordinate plane (e.g. XY, YZ, ZX).

6 Geometric tests for axes of linear motion

<b>Object</b>	<b>G1</b>												
Checking of the straightness of motion of the table ( $X'$ -axis) in the horizontal $XY$ plane, $E_{YX'}$ .													
<b>Diagram</b>													
 <p>The diagram illustrates the measurement setup. A horizontal table is shown with a taut wire (1) stretched across it. A microscope (2) is positioned above the wire to measure its straightness. A coordinate system is defined with the <math>X'</math>-axis pointing left and the <math>Z</math>-axis pointing up. A double-headed arrow on the table indicates the direction of motion along the <math>X'</math>-axis.</p>													
<b>Key</b>													
1 taut wire	2 microscope												
<b>Tolerance</b>													
<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="4" style="text-align: center;">For a measuring length up to</th> </tr> <tr> <th style="text-align: center;">2 500</th> <th style="text-align: center;">5 000</th> <th style="text-align: center;">7 500</th> <th style="text-align: center;">10 000</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0,025</td> <td style="text-align: center;">0,050</td> <td style="text-align: center;">0,075</td> <td style="text-align: center;">0,100</td> </tr> </tbody> </table>		For a measuring length up to				2 500	5 000	7 500	10 000	0,025	0,050	0,075	0,100
For a measuring length up to													
2 500	5 000	7 500	10 000										
0,025	0,050	0,075	0,100										
The local tolerance is 0,010 for any measuring length of 1 000.													
For measuring lengths over 10 000, the tolerance shall be agreed between manufacturer/supplier and user.													
<b>Measurement results</b>	For a measuring length of:												
<b>Measuring instruments</b>													
Microscope and taut wire or other straightness measurement optical instruments.													
<b>Observations and references to ISO 230-1:2012, 8.2.2.1, 8.2.2.2, 8.2.2.3 and 8.2.2.4</b>													
The microscope shall be fixed on the spindle, if it can be locked, or on the spindle head.													
When optical instruments are used, it should be considered that, their measurement uncertainty for long measurement length can be higher than the measurement uncertainty of microscope and taut wire.													
Measurements shall be carried out on at least six positions along the travel, with equally spaced steps not exceeding 500. Traverse the table in the $X'$ -axis direction and note the readings.													
Measurements shall be with $Y$ - and $Z$ -axes at their mid travel positions or otherwise, measurement location shall be reported.													

<b>Object</b>	<b>G2</b>		
Checking of the straightness of motion of representative points of the table (X'-axis) in the vertical ZX plane, $E_{ZX}$ .			
<b>Diagram</b>			
<b>Key</b>			
1 target	2 laser scanning device		
<b>Tolerance</b>			
<b>For a measuring length up to</b>			
2 500	5 000	7 500	10 000
0,050	0,100	0,150	0,200
The local tolerance is 0,020 for any measuring length of 1 000.			
For measuring lengths over 10 000, the tolerance shall be agreed between manufacturer/supplier and user.			
<b>Measurement results</b> For a measuring length of:			
<b>Measuring instruments</b>			
Laser scanning device or straightness measurement optical instruments excluding microscope and taut wire.			
<b>Observations and references to ISO 230-1:2012, 8.2.2.1, 8.2.2.3 and 8.2.2.4</b>			
Taut wire is not recommended because of the sag of the wire.			
The laser scanning device can be mounted on the spindle head so that the optical plane is parallel to the X'-axis motion, or the lack of parallelism shall be considered in the measurement. If the instrument is mounted on the table, small local angular errors will be improperly magnified.			
The target can be mounted on a representative point on the table.			
Measurements shall be carried out on at least six positions along the travel, with equally spaced steps not exceeding 500. Traverse the table in the X'-axis direction and note the readings.			
Measurements shall be with Y- and Z-axes at their mid travel positions or otherwise, measurement location shall be reported.			
The rigid body model is typically not applicable to the motion of the table.			
The target shall be placed at the two ends of the table and possibly in the middle of the table. Each measurement result shall be reported.			
The target located at one end of the table explores the characteristics of half of the bed.			
The target located in the middle of the table typically reveals different deviations from the ones located at both ends of the table.			
See <a href="#">Annex B</a> for information on methods to be applied to minimize the effect of non-rigid body behaviour of the table motion on measurement uncertainty.			