Form 36

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Title: Draft BS ISO 8636-1 Machine tools — Test conditions for bridge-type milling machines. Part 1: Testing of the accuracy of fixed bridge (portal-type) machines.

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex **(e.g. 3.1)**	Paragraph/ Figure/Table/Note	**Type of comment**	**Commend (justification for change) by the MB**	**Proposed change by the MB**	**Secretariat observations on each comment submitted**
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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DRAFT International Standard

ISO/DIS 8636-1

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

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

ICS: 25.080.20

ISO/TC **39**/SC **2**

Secretariat: **ASI**

Voting begins on:
2025-01-22

Voting terminates on:
2025-04-16

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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 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 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.

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 compared to the previous edition are as follows:

— references in Observations have been updated to ISO 230-1:2012 and to ISO 230-2:2014,

— the original Clause 3 “Definitions and descriptions” has been renamed “Terms and definitions” to comply with current prescriptions of ISO/IEC Directives Part 2,

— 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 sub-clauses 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 (Informative),

— a new Annex B provides 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,

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

— tests for tilting spindle heads (formerly G15 and P7) have been deleted as such heads are not in the scope of this document. They might be considered in a future standard,

— 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.

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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 230-1:2012, ISO 230-2:2014, ISO 230-7:2015 and the following apply.

ISO and IEC maintain terminological 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/

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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 operations
operations 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 below. The number indicated in brackets corresponds to the relevant key in Figure 1.

4.2.2 Bed and table

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

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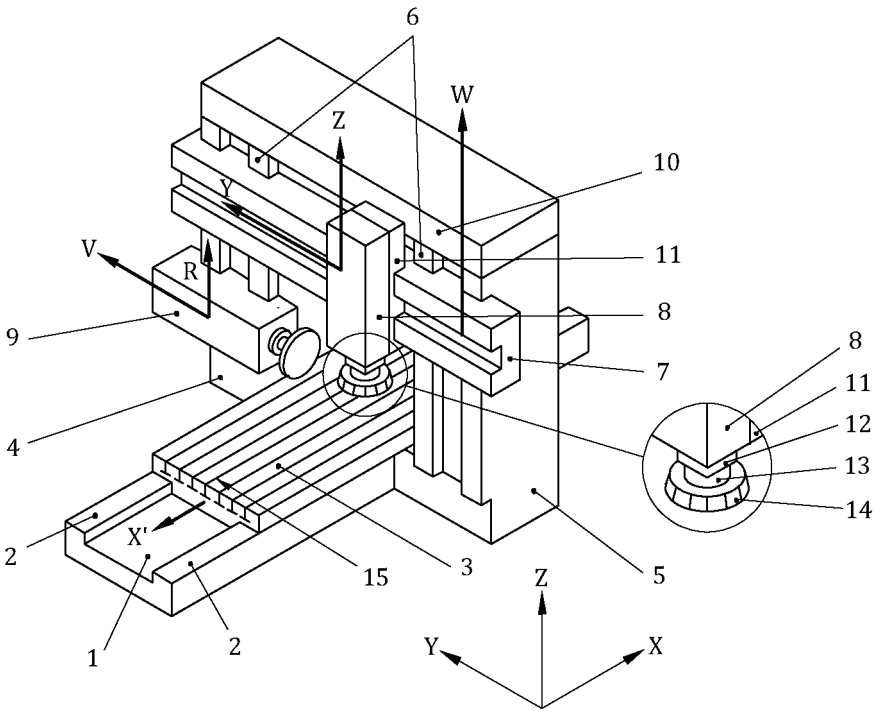

Key

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

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

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

The columns (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 (6) to accommodate horizontal spindle head (9) with other horizontal spindle axis.

The tie-piece (10) is a fixed piece connecting both columns at, or near, the top.

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

The variable height cross-rail, where available, can be moved up and down the vertical slideways (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.

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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 (13) can be mounted in a ram or quill (12) with a feed motion for drilling, tapping or boring 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.

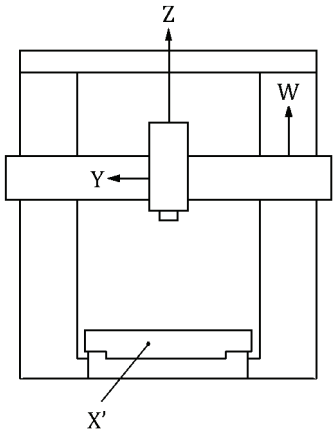

Figure 2 — Portal type machine tool with one spindle head

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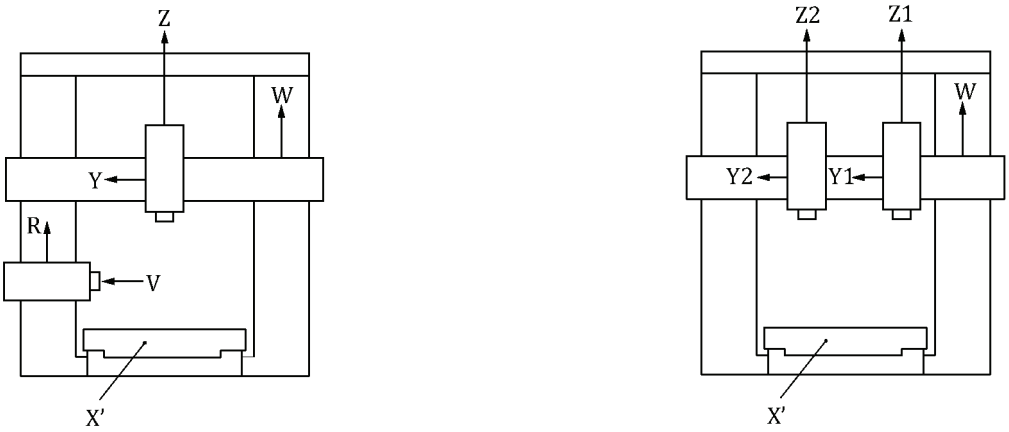

a) One vertical spindle head placed on the cross-rail, and one horizontal spindle head placed on the left-hand column

b) Two vertical spindle heads on the cross-rail

Figure 3 — Portal type machine tools with two spindle heads

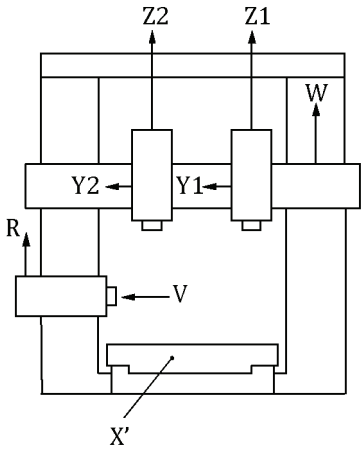

Figure 4 — Portal type machine tool with three spindle heads

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 (µrad) or arcseconds (“) are used for clarification purposes. The following formula (1) should be used for the conversion of the units of angular errors or tolerances:

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

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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 compliance with the specifications of one of those parts of 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 analog 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.

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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 compliance 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).

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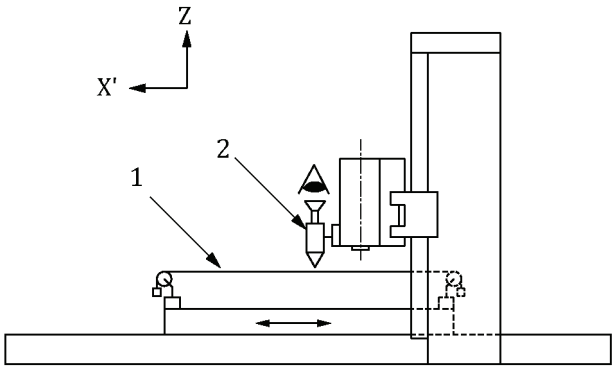
6 Geometric tests for axes of linear motion

Object	**G1**
Checking of the straightness of motion of the table (X'-axis) in the horizontal XY plane, $E_{YX'}$.	

Diagram



Key

1 taut wire 2 microscope

Tolerance

For a measuring length up to:

2 500	5 000	7 500	10 000
0,025	0,050	0,075	0,100

Local tolerance: 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.

Measurement results: For a measuring length of:

Measuring instruments

Microscope and taut wire or other straightness measurement optical instruments

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

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-axis at their mid travel positions or otherwise, measurement location shall be reported.

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