

	Test conditions for machining centres Part 3: Geometric tests for machines with integral indexable or continuous universal heads (vertical Z-axis) (ISO 10791-3 : 1998)	DIN ISO 10791-3
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ICS 25.040.10

Werkzeugmaschinen – Prüfbedingungen für Bearbeitungszentren – Teil 3: Geometrische Prüfungen für Maschinen mit eingebautem schaltbaren oder stetig bewegtem Universal-Fräskopf (senkrechte Z-Achse) (ISO 10791-3 : 1998)

This standard incorporates International Standard

ISO 10791-3 Test conditions for machining centres – Part 3: Geometric tests for machines with integral indexable or continuous universal heads (vertical Z-axis).

A comma is used as the decimal marker.

National foreword

This standard has been prepared by ISO/TC 39 'Machine tools', SC 2 'Test conditions for metall cutting machine tools'.

The responsible German body involved in its preparation was the *Normenausschuss Werkzeugmaschinen* (Machine Tools Standards Committee).

DIN ISO 230-1 is the standard corresponding to International Standard ISO 230-1 referred to in clause 2 of the ISO Standard.

National Annex NA

Standard referred to

(and not included in **Normative reference** and **Annex D**)

DIN ISO 230-1 Test code for machine tools – Part 1: Geometric accuracy of machines operating under no-load or finishing conditions (ISO 230-1 : 1996)

ISO Standard comprises 51 pages.

Test conditions for machining centres

Part 3: Geometric tests for machines with integral indexable or continuous universal heads (vertical Z-axis)

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10791-3 was prepared by Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 2, *Test conditions for metal cutting machine tools*.

ISO 10791 consists of the following parts, under the general title *Test conditions for machining centres*:

- *Part 1: Geometric tests for machines with horizontal spindle and with accessory heads (horizontal Z-axis)*
- *Part 2: Geometric tests for machines with vertical spindle or universal heads with vertical primary rotary axis (vertical Z-axis)*
- *Part 3: Geometric tests for machines with integral indexable or continuous universal heads (vertical Z-axis)*
- *Part 4: Accuracy and repeatability of positioning of linear and rotary axes*
- *Part 5: Accuracy and repeatability of positioning of work-holding pallets*
- *Part 6: Accuracy of feeds, speeds and interpolations*
- *Part 7: Accuracy of a finished test piece*
- *Part 8: Evaluation of the contouring performance in the three coordinate planes*
- *Part 9: Evaluation of the operating times of tool change and pallet change*
- *Part 10: Evaluation of the thermal distortions*
- *Part 11: Evaluation of the noise emission*

Annexes A B and C form an integral part of this part of ISO 10791. Annex D is for information only.

Introduction

A machining centre is a numerically controlled machine tool capable of performing multiple machining operations, including milling, boring, drilling and tapping, as well as automatic tool changing from a magazine or similar storage unit in accordance with a machining programme.

The object of ISO 10791 is to supply information as wide and comprehensive as possible on tests which can be carried out for comparison, acceptance, maintenance or any other purpose.

ISO 10791 specifies, with reference to the relevant parts of ISO 230, *Test code for machine tools*, several families of tests for machining centres with horizontal or vertical spindle or with universal heads of different types, standing alone or integrated in flexible manufacturing systems. ISO 10791 also establishes the tolerances or maximum acceptable values for the test results corresponding to general purpose and normal accuracy machining centres.

ISO 10791 is also applicable, totally or partially, to numerically controlled milling and boring machines, when their configuration, components and movements are compatible with the tests described herein.

1 Scope

This part of ISO 10791 specifies, with reference to ISO 230-1, the geometric tests for machining centres (or numerically controlled milling machines, boring machines, etc., where applicable) with integral indexable or continuous universal heads (vertical Z-axis).

This part of ISO 10791 applies to machining centres having basically six numerically controlled axes, of which three are linear (X, Y and Z) up to 2 000 mm in length, and three are rotary (A or D and B on the head, and C' on the table). Movements other than those mentioned are considered as special features and the relevant tests are not included in this part of ISO 10791.

This part of ISO 10791 describes geometric tests for three possible types of accessory universal heads, in the annexes:

- annex A: Integral universal 45° split indexable heads (B and D axes), with mechanical indexing of the different angular positions of the two bodies (e.g. Hirth couplings): the relevant tests (AG1 to AG9) check only the resulting position of the spindle;
- annex B: Integral universal swivel heads (B and A axes), with two numerically controlled rotary axes perpendicular to each other (tests BG1 to BG7);
- annex C: Integral universal 45° split continuous heads (B and D axes), similar to the first type but provided with continuous positioning of the two numerically controlled rotary axes: the relevant tests (CG1 to CG7) check all the geometric features (planes and axes) which contribute to the resulting position of the spindle, excluding the positioning accuracy of the two rotary axes; these tests can also be used for a deeper investigation on the 45° indexable heads, if their movements and locks allow this.

This part of ISO 10791 deals only with the verification of accuracy of the machine and does not apply to the testing of the machine operation, which should generally be checked separately. Certain tests concerning the performance of the machine operating under no-load or finishing conditions are included in other parts of ISO 10791.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 10791. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10791 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 230-1:1996, *Test code for machine tools — Part 1: Geometric accuracy of machines operating under no-load or finishing conditions*.

3 Preliminary remarks

3.1 Measuring units

In this part of ISO 10791, all linear dimensions, deviations and corresponding tolerances are expressed in millimetres; angular dimensions are expressed in degrees, and angular deviations and the corresponding tolerances are expressed in ratios, but in some cases microradians or arc seconds may be used for clarification purposes. The equivalence of the following expressions should always be kept in mind:

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

3.2 Reference to ISO 230-1

To apply this part of ISO 10791, 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 accuracy of testing equipment.

In the "Observations" block of the tests described in clause 4 and annexes A to C, the instructions are followed by a reference to the corresponding clause in ISO 230-1 in cases where the test concerned is in compliance with the specifications of ISO 230-1.

3.3 Testing sequence

The sequence in which the tests are presented in this part of ISO 10791 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.

3.4 Tests to be performed

When testing a machine, it is not always necessary nor possible to carry out all the tests described in this part of ISO 10791. 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. Mere reference to this part of ISO 10791 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.

3.5 Measuring instruments

The measuring instruments indicated in the tests described in clause 4 and annexes A to C are examples only. Other instruments measuring the same quantities and having at least the same accuracy may be used. Dial gauges shall have a resolution of 0,001 mm or better.

3.6 Diagrams

In this part of ISO 10791, for reasons of simplicity, the diagrams associated with geometric tests illustrate only one type of machine.