
Test code for machine tools —
Part 3:
Determination of thermal effects

Code d'essai des machines-outils —

Partie 3: Évaluation des effets thermiques



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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 230-3 was prepared by Technical Committee 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 230-3:2001), which has been technically revised.

ISO 230 consists of the following parts, under the general title *Test code for machine tools*:

- *Part 1: Geometric accuracy of machines operating under no-load or finishing conditions*
- *Part 2: Determination of accuracy and repeatability of positioning numerically controlled axes*
- *Part 3: Determination of thermal effects*
- *Part 4: Circular tests for numerically controlled machine tools*
- *Part 5: Determination of the noise emission*
- *Part 6: Determination of positioning accuracy on body and face diagonals (Diagonal displacement tests)*
- *Part 7: Geometric accuracy of axes of rotation*
- *Part 9: Estimation of measurement uncertainty for machine tool tests according to series 230, basic equations [Technical Report]*

The following part is under preparation:

- *Part 8: Determination of vibration levels [Technical Report]*

Determination of the measuring performance of a machine tool is to form the subject of a future part 10.

Introduction

The purpose of ISO 230 is to standardize methods for testing the accuracy of machine tools, excluding portable power tools.

This part of ISO 230 specifies test procedures for determining thermal effects caused by a variety of heat inputs resulting in the distortions of a machine tool structure or the positioning system. It is a recognized fact that the ultimate thermo-elastic deformation of a machine tool is closely linked to the operating conditions. The test conditions described in this part of ISO 230 are not intended to simulate the normal operating conditions, but to facilitate performance estimation and the determination of the effects of environment on machine performance. For example, use of coolants may significantly affect the actual thermal behaviour of the machine. Therefore, these tests should be considered only as the preliminary tests towards the determination of actual thermo-elastic behaviour of the machine tool if such determination becomes necessary for machine characterization purposes. The tests are designed to measure the relative displacements between the component that holds the tool and the component that holds the workpiece as a result of thermal expansion or contraction of relevant structural elements.

The tests specified in this part of ISO 230 can be used either for testing different types of machine tool (type testing) or individual machine tools for acceptance purposes. When the tests are required for acceptance purposes, it is up to the user to choose, in agreement with the supplier/manufacture, those tests relating to the properties of the components of the machine which are of interest. The mere reference to this part of the test code for the acceptance tests, without agreement on the parts to be applied and the relevant charges, cannot be considered as binding for one or other of the contracting parties. One significant feature of this part of ISO 230 is its emphasis on environmental thermal effects on all the performance tests described in other parts of ISO 230 related to linear displacement measurements (such as linear displacement accuracy, repeatability and the circular tests). The supplier/manufacture will need to provide thermal specifications for the environment in which the machine can be expected to perform with the specified accuracy. The machine user will be responsible for providing a suitable test environment by meeting the supplier's/manufacture's thermal guidelines or otherwise accepting reduced performance. An example of environmental thermal guidelines is given in Annex C.

A relaxation of accuracy expectations is required if the thermal environment causes excessive uncertainty or variation in the machine tool performance and does not meet the supplier's/manufacture's thermal guidelines. If the machine does not meet the performance specifications, the analysis of the combined standard thermal uncertainty provides help in identifying sources of problems. Combined standard thermal uncertainty is defined in 3.6, as well as in ISO/TR 16015.

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Test code for machine tools —

Part 3: Determination of thermal effects

1 Scope

This part of ISO 230 defines three tests for the determination of thermal effects on machine tools:

- an environmental temperature variation error (ETVE) test;
- a test for thermal distortion caused by rotating spindles;
- a test for thermal distortion caused by moving linear axes.

The test for thermal distortion caused by moving linear axes (see Clause 7) is applicable to numerically controlled (NC) machines only and is designed to quantify the effects of thermal expansion and contraction as well as the rotational deformation of structure. For practical reasons, it is applicable to machines with linear axes up to 2 000 mm in length. If used for machines with axes longer than 2 000 mm, it will be necessary to choose a representative length of 2 000 mm in the normal range of each axis for the tests.

The tests correspond to drift tests according to ISO/TR 16015 and define the evaluation and the detailed procedure for machine tools.

NOTE It is not foreseen that numerical tolerances will be determined for the tests specified in this part of ISO 230.

2 Normative references

The following referenced documents are indispensable for the application 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 1:2002, *Geometrical Product Specifications (GPS) — Standard reference temperature for geometrical product specification and verification*

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

ISO/TR 16015:2003, *Geometrical product specifications (GPS) — Systematic errors and contributions to measurement uncertainty of length measurement due to thermal influences*