
**Test conditions for numerically
controlled turning machines and turning
centres —**

**Part 8:
Evaluation of thermal distortions**

*Conditions d'essai des tours à commande numérique et des centres de
tournage —*

Partie 8: Évaluation des effets thermiques

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 13041-8 was prepared by Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 2, *Test conditions for metal cutting machine tools*.

ISO 13041 consists of the following parts, under the general title *Test conditions for numerically controlled turning machines and turning centres*:

- *Part 1: Geometric tests for machines with a horizontal workholding spindle*
- *Part 2: Geometric tests for machines with vertical workholding spindle*
- *Part 3: Geometric tests for machines with inverted vertical workholding spindle*
- *Part 4: Accuracy and repeatability of positioning of linear and rotary axes*
- *Part 5: Accuracy of feeds, speeds and interpolations*
- *Part 6: Accuracy of a finished test piece*
- *Part 7: Evaluation of contouring performance in the coordinate planes*
- *Part 8: Evaluation of thermal distortions*

Introduction

The object of ISO 13041 is to supply information as wide and comprehensive as possible on geometric, positional, contouring, thermal and machining tests which can be carried out for comparison, acceptance, maintenance or any other purpose.

ISO 13041 specifies, with reference to the relevant parts of ISO 230, *Test code for machine tools*, tests for turning centres and numerically controlled turning machines with/without tailstocks standing alone or integrated in flexible manufacturing systems. ISO 13041 also establishes the tolerances or maximum acceptable values for the test results corresponding to general purpose and normal-accuracy turning centres and numerically controlled turning machines.

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Test conditions for numerically controlled turning machines and turning centres —

Part 8: Evaluation of thermal distortions

1 Scope

This part of ISO 13041 specifies, with reference to ISO 230-3, the tests which apply for the evaluation of thermal distortions of the machine structure and positioning system, up to 2 000 mm in length, of numerically controlled (NC) turning machines and turning centres.

Hence, this part of ISO 13041 defines three tests which are

- the environmental temperature-variation error test,
- the test for thermal distortion caused by a rotating spindle, and
- the test for thermal distortion caused by moving linear axes.

It should be noted that there is no intention of assigning any numerical tolerances associated with the tests described in this part of ISO 13041.

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

ISO 230-3:2001, *Test code for machine tools — Part 3: Determination of thermal effects*

ISO 13041-1:2003, *Test conditions for numerically controlled turning machines and turning centres — Part 1: Geometric tests for machines with a horizontal spindle*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13041-1 apply.

4 Preliminary remarks

4.1 Reference to ISO 230-3

To apply this part of ISO 13041, reference shall be made to ISO 230-3, especially for the installation of the machine before testing, description of measuring methods and presentation of the results.

4.2 Testing sequence

The tests in this part of ISO 13041 may be used either separately or in any combination.

4.3 Tests to be performed

When testing a machine, it is not always necessary or possible to carry out all the tests described in this part of ISO 13041. 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 13041 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 Environmental Temperature Variation (ETVE) test

5.1 General

ETVE tests are designed to reveal the effects of environmental temperature changes on the machine. They shall not be used for machine comparison.

It is recommended that the supplier/manufacturer should offer guidelines regarding what kind of thermal environment should be acceptable for the machine to perform with the specified accuracy. It shall be the responsibility of the user to provide an acceptable thermal environment for the operation. However, if the user follows the guidelines provided by the machine supplier/manufacturer, the responsibility for machine performance according to the specification reverts to the machine supplier/manufacturer.

5.2 Test method

The test method shall be in accordance with those defined in 5.2 of ISO 230-3. The ETVE test should last for a minimum of 4 h; if the readings of the measuring instruments still show any drift, the test should be continued up to a maximum of 24 h.

NOTE Vertical and slant-bed axes might warm up when under NC "HOLD" command. In such cases, it is recommended to execute the ETVE test with all controls "OFF". This should be stated in the test protocol.

5.3 Measuring instruments

The measuring instruments are as follows: linear displacement probe, temperature sensors, test mandrel and data acquisition equipment.

5.4 Presentation of results

Table 1 provides an example of the format for the presentation of the results; in addition, a graphical presentation of results should be provided as specified in 5.3 of ISO 230-3:2001.