

---

---

**Test conditions for machining  
centres —**

**Part 6:  
Accuracy of speeds and interpolations**

*Conditions d'essai pour centres d'usinage —*

*Partie 6: Précision des vitesses et interpolations*



This document is a preview generated by EBS



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2014

All rights reserved. Unless otherwise specified, 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  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b>	<b>iv</b>
<b>Introduction</b>	<b>v</b>
<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 Preliminary remarks</b>	<b>2</b>
4.1 Measurement units	2
4.2 Reference to ISO 230-1 and ISO 230-4	2
4.3 Testing sequence	2
4.4 Tests to be performed	2
4.5 Measuring instruments	2
4.6 Diagrams	2
4.7 Position of axes not under test	2
4.8 Software compensation	3
<b>5 Kinematic tests</b>	<b>3</b>
5.1 General	3
5.1.1 Tests described in <a href="#">Annexes A to C</a>	3
5.1.2 Alternative tests in <a href="#">Annexes A</a> and <a href="#">C</a>	3
5.2 Spindle speeds and feed speeds	4
5.3 Linear interpolation motion	7
5.4 Circular interpolation motion	9
<b>Annex A (normative) Kinematic tests for machines with two rotary axes in the spindle head</b>	<b>11</b>
<b>Annex B (normative) Kinematic tests for machines with two rotary axes in the workpiece side</b>	<b>23</b>
<b>Annex C (normative) Kinematic tests for machines with a swivel head and/or a rotary table</b>	<b>34</b>
<b>Annex D (informative) Precautions for test setup for <a href="#">Annexes A to C</a></b>	<b>44</b>
<b>Bibliography</b>	<b>50</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)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is 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 10791-6:1998), which has been technically revised. It also incorporates Technical Corrigendum ISO 10791-6:1998/Cor 1:2004.

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 (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 speeds and interpolations*
- *Part 7: Accuracy of finished test pieces*
- *Part 8: Evaluation of contouring performance in the three coordinate planes*
- *Part 9: Evaluation of the operating times of tool change and pallet change*
- *Part 10: Evaluation of thermal distortions*

## Introduction

ISO 10791 is concerned with methods of testing machining centres.

A machining centre is a numerically controlled machine tool capable of performing multiple machining operations, including milling, boring, 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 deemed necessary by the user or the manufacturer.

ISO 10791 specifies, with reference to the relevant parts of ISO 230, several families of tests for machining centres. 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.

In five-axis machining centres having three orthogonal linear axes and two rotary axes, there are such types as machines with two rotary axes in the spindle head (see [Annex A](#)), machines with two rotary axes in the workpiece side (see [Annex B](#)), and machines with a swivel head and/or a rotary table (see [Annex C](#)).

The annexes of this part of ISO 10791 specify the kinematic tests for five-axis machining centres.



# Test conditions for machining centres —

## Part 6:

## Accuracy of speeds and interpolations

### 1 Scope

This part of ISO 10791 specifies, with reference to ISO 230-1 and ISO 230-4, certain kinematic tests for machining centres, concerning spindle speeds, feed and the accuracy of the paths described by the simultaneous movement of two or more numerically controlled (NC) linear and/or rotary axes.

This part of ISO 10791 applies to machining centres having three linear axes (X, Y, and Z) and additionally one or two rotary axes (A, B, or C). 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 deals only with the verification of kinematic accuracy of the machine and does not apply to the testing of the machine operation, e.g. vibrations, abnormal noises, etc., which should generally be checked separately.

The tests described in this part of ISO 10791 are also applicable, totally or partially, subject to specific agreement between the manufacturer/supplier and the user, to numerically controlled milling and boring machines, when their configuration, components, and movements are compatible with the tests described herein.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 230-4:2005, *Test code for machine tools — Part 4: Circular tests for numerically controlled machine tools*

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

ISO 841:2001, *Industrial automation systems and integration — Numerical control of machines — Coordinate system and motion nomenclature*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 230-1, ISO 230-4, ISO 230-7, and ISO 841 and the following apply.

#### 3.1

##### **linear interpolation**

interpolation where relative motion between the tool side and the workpiece side of the machine tool is a straight line obtained by controlling multiple axes simultaneously

#### 3.2

##### **circular interpolation**

interpolation where relative motion between the tool side and the workpiece side of the machine tool is a circular arc in a specific plane obtained by controlling multiple axes simultaneously