

---

---

**Machine tools — Test conditions for  
universal spindle heads —**

**Part 1:  
Accessory heads for machines with  
horizontal spindle (horizontal Z-axis)**

*Machines-outils — Conditions d'essai pour poupées porte-broche  
universelles —*

*Partie 1: Têtes accessoires pour machines à broche horizontale (axe Z  
horizontal)*



This document is a preview generated by EMS



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, 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  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [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>2</b>
<b>4 Preliminary remarks</b> .....	<b>6</b>
4.1 Measurement units.....	6
4.2 Reference to ISO 230.....	6
4.3 Testing sequence.....	6
4.4 Tests to be performed.....	6
4.5 Measuring instruments.....	7
4.6 Software compensation.....	7
4.6.1 Head offset compensation.....	7
4.6.2 Machine geometric compensation.....	8
4.7 Diagrams.....	8
4.8 Measuring length.....	8
4.9 Tolerances.....	8
<b>5 Common geometric tests for spindles of all types of heads</b> .....	<b>9</b>
<b>6 Geometric tests for all types of spindle heads</b> .....	<b>11</b>
<b>7 Angular positioning tests</b> .....	<b>27</b>
<b>Annex A (informative) Supplementary geometric tests for 45° split continuous heads</b> .....	<b>28</b>
<b>Annex B (informative) Supplementary geometric tests for swivelling heads</b> .....	<b>36</b>
<b>Annex C (informative) Tests for checking the accuracy of spindle axes of rotation</b> .....	<b>46</b>
<b>Bibliography</b> .....	<b>48</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 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](http://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*.

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](http://www.iso.org/members.html).

## Introduction

Accessory spindle heads are used on machine tools such as milling and boring machines, machining centres, portal and gantry type machines, turning centres, with only one built-in spindle in the head or ram, providing fixed or indexing or tilting spindles which can be oriented in directions different from the built-in spindle axis.

In the same way as the built-in spindle, they can perform multiple machining operations including milling, boring, drilling, grinding and tapping, and, in some cases, automatic tool changing as well from a magazine or similar storage unit in accordance with a machining program.

Some types of heads allow to check only the resulting position of the spindle (as the fixed or indexing ones considered in [3.3](#), [3.4](#) and [3.5](#) and in tests G1 to G15), whereas for some others, i.e. those with continuous movement of the two rotary axes (as those considered in [3.6](#) and [3.7](#)). [Annexes A](#) and [B](#) allow to make additional analysis of the relative positions between axes and to check the accuracy of their offset compensation as well.



# Machine tools — Test conditions for universal spindle heads —

## Part 1:

## Accessory heads for machines with horizontal spindle (horizontal Z-axis)

### 1 Scope

This document specifies, with reference to the ISO 230 series, some families of tests for accessory spindle heads used on machining centres or numerically controlled milling machines, etc., where applicable, with horizontal spindle (i.e. horizontal Z-axis). The tests considered in this document are also applicable to manual indexing heads.

This document establishes the tolerances or maximum acceptable values for the test results corresponding to general purpose and normal accuracy spindle heads used on different types of machines.

This document specifies several sets of procedures for geometric tests which can be carried out on different types of spindle heads for comparison, acceptance, maintenance, adjustments or any other purpose.

Grinding heads and facing heads are not included in the scope of this document.

This document deals only with the verification of geometric and positioning accuracy of the accessory spindle heads and does not apply to:

- the testing of the machine's head(s) operation (e.g. vibration, abnormal sound noise level, stick slip motion of components);
- the machine's spindle head(s) characteristics (e.g. speeds, feeds and accelerations) which are generally checked separately; or
- the verification of the machining capability under power.

Tests concerning the accuracy of finished test pieces are dealt with in other ISO standards.

### 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*