

# ISO 230-7:2015-05 (E)

## Test code for machine tools - Part 7: Geometric accuracy of axes of rotation

---

<b>Contents</b>		<b>Page</b>
Foreword .....		v
Introduction .....		vi
<b>1</b>	<b>Scope .....</b>	<b>1</b>
<b>2</b>	<b>Normative references .....</b>	<b>1</b>
<b>3</b>	<b>Terms and definitions .....</b>	<b>2</b>
3.1	General concepts .....	2
3.2	Error motion terms .....	6
3.3	Consequences of axis of rotation error motion .....	8
3.4	Directional decomposition of axis of rotation error motion .....	10
3.5	Decomposition of measured axis of rotation error motion based on rotational frequency ..	11
3.6	Terms for axis of rotation error motion polar plots .....	12
3.7	Terms for axis of rotation error motion polar plot centres .....	14
3.8	Terms for axis of rotation error motion values .....	15
3.9	Terms for structural error motion .....	17
3.10	Terms for axis shift .....	17
<b>4</b>	<b>Preliminary remarks .....</b>	<b>18</b>
4.1	Measuring units .....	18
4.3	Recommended instrumentation and test equipment .....	18
4.4	Environment .....	19
4.5	Rotary component to be tested .....	19
4.6	Rotary component warm-up .....	19
4.7	Structural error motion tests .....	19
4.7.1	General .....	19
4.7.2	Test procedure .....	19
4.7.3	Analysis of results .....	19
<b>5</b>	<b>Error motion test methods for machine tool spindle units .....</b>	<b>20</b>
5.1	General .....	20
5.2	Test parameters and specifications .....	20
5.3	Spindle axis of rotation tests -- Rotating sensitive direction(s) .....	20
5.3.1	General .....	20
5.3.2	Radial error motion .....	20
5.3.3	Tilt error motion .....	23
5.3.4	Axial error motion .....	25
5.4	Spindle tests -- Fixed sensitive direction .....	26
5.4.1	General .....	26
5.4.2	Test setup .....	26
5.4.3	Radial error motion .....	27
5.4.4	Axial error motion .....	29
5.4.5	Tilt error motion .....	30
<b>6</b>	<b>Error motion test methods for machine tool rotary tables/heads .....</b>	<b>31</b>
6.1	General .....	31
6.2	Axial error motion .....	31
6.2.1	Test setup .....	31
6.2.2	Test procedure .....	32
6.2.3	Data analysis .....	32

<b>6.3</b>	<b>Radial error motion .....</b>	<b>33</b>
<b>6.3.1</b>	<b>Test setup .....</b>	<b>33</b>
<b>6.3.2</b>	<b>Test procedure .....</b>	<b>33</b>
<b>6.3.3</b>	<b>Data analysis for rotating sensitive direction .....</b>	<b>33</b>
<b>6.3.4</b>	<b>Data analysis for fixed sensitive direction .....</b>	<b>34</b>
<b>6.4</b>	<b>Tilt error motion .....</b>	<b>34</b>
<b>6.4.1</b>	<b>Test setup .....</b>	<b>34</b>
<b>6.4.2</b>	<b>Test procedure .....</b>	<b>34</b>
<b>6.4.3</b>	<b>Data analysis for rotating sensitive direction .....</b>	<b>34</b>
<b>6.4.4</b>	<b>Data analysis for fixed sensitive direction .....</b>	<b>35</b>
<b>Annex A (informative)</b>	<b>Discussion of general concepts .....</b>	<b>36</b>
<b>Annex B (informative)</b>	<b>Elimination of reference sphere roundness error .....</b>	<b>55</b>
<b>Annex C (informative)</b>	<b>Terms and definitions for compliance properties of axis of rotation .....</b>	<b>59</b>
<b>Annex D (informative)</b>	<b>Terms and definitions for thermally-induced errors associated with rotation of spindle and rotary tables/heads .....</b>	<b>60</b>
<b>Annex E (informative)</b>	<b>Static error motion tests .....</b>	<b>61</b>
<b>Annex F (informative)</b>	<b>Measurement uncertainty estimation for axis of rotation tests .....</b>	<b>62</b>
<b>Annex G (informative)</b>	<b>Alphabetical cross-reference of terms and definitions .....</b>	<b>67</b>
<b>Annex H (informative)</b>	<b>Linear displacement sensor bandwidth and rotational speed .....</b>	<b>69</b>
<b>Bibliography .....</b>		<b>72</b>