BRITISH STANDARD

BS ISO 3875:2004

Machine tools — Test conditions for external cylindrical centreless grinding machines — Testing of the accuracy

ICS 25.080.50

National foreword

This British Standard reproduces verbatim ISO 3875:2004 and implements it as the UK national standard. It supersedes BS 4656-24:1993 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MTE/1, Machine tools, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, the ISO title page, pages ii to iv, pages 1 to 15 and a back cover.

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INTERNATIONAL STANDARD

ISO 3875

Third edition
2004-01-15

Machine tools — Test conditions for external cylindrical centreless grinding machines — Testing of the accuracy

Conditions d'essai des machines à rectifier les surfaces extérieures sans centres — Contrôle de la précision

Reference number
ISO 3875:2004(E)

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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 3875 was prepared by Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 2, *Test conditions for metal cutting machine tools*.

This third edition cancels and replaces the second edition (ISO 3875:1990), which has been technically revised.

Machine tools — Test conditions for external cylindrical centreless grinding machines — Testing of the accuracy

1 Scope

The International Standard specifies, with reference to ISO 230-1 and 230-2, geometric tests, machining tests and tests for accuracy and repeatability of positioning axes on general purpose and normal accuracy external cylindrical centreless grinding machines. It also specifies the applicable tolerances corresponding to the above-mentioned tests.

This International Standard deals only with the verification of accuracy of the machine. It does not apply to the testing of the machine operation (vibrations, abnormal noise, stick-slip motion of components, etc.) nor to machine characteristics (such as speeds, feeds, etc.), which should generally be checked before testing of machine accuracy.

This International Standard provides the terminology used for the principal components of the machine and the designation of the axes with reference to ISO 841.

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 230-2:1997, *Test code for machine tools — Part 2: Determination of accuracy and repeatability of positioning numerically controlled axes*

3 Terminology and design of axes

See Figure 1 and Table 1.

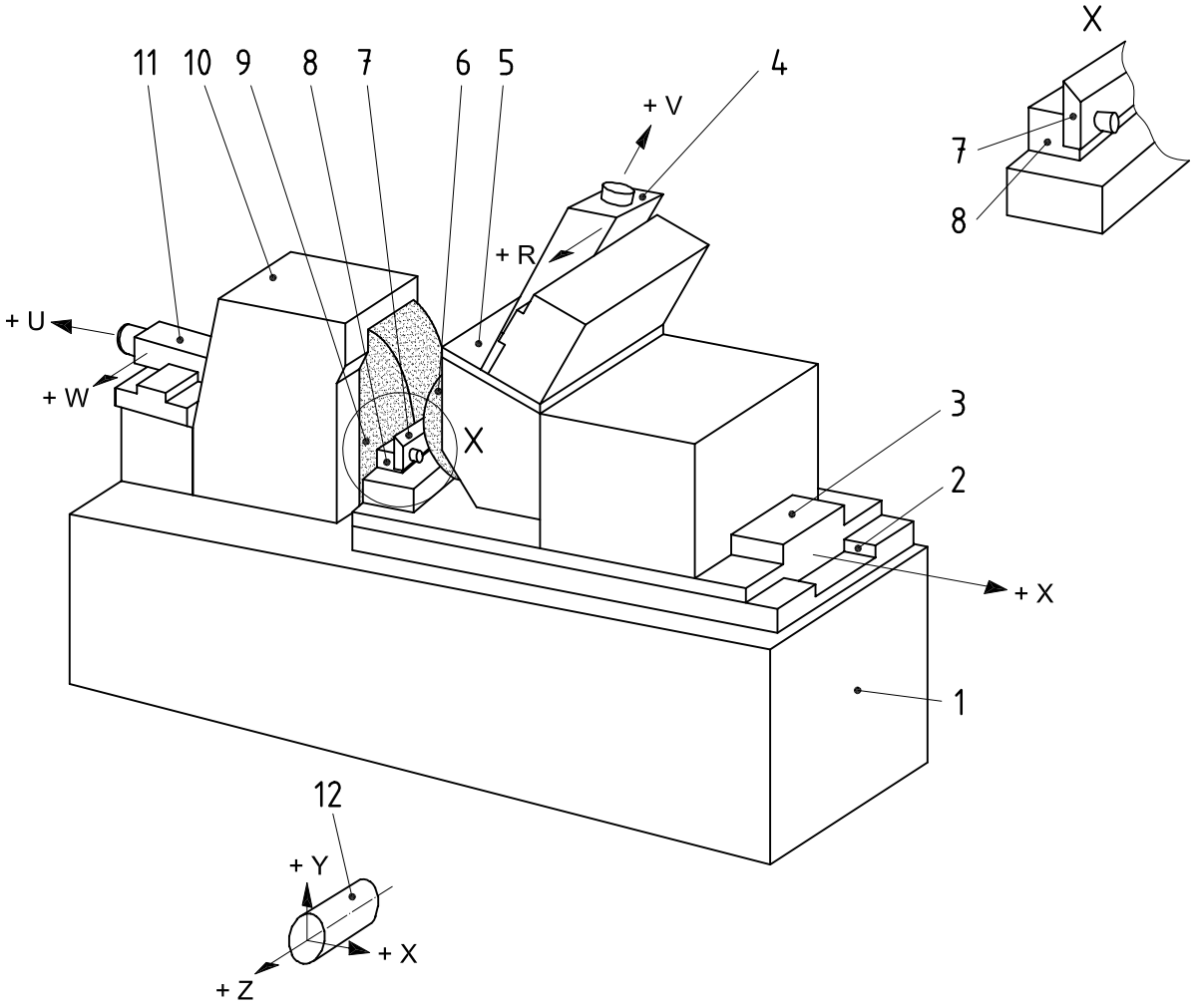


Figure 1 — Example of a centreless grinding machine

Table 1 — Terminology

Ref.	English	French	German
1	Bed	Banc	Bett
2	Saddle guideway	Guidage de chariot	Schlittenführung
3	Saddle	Chariot	Schlitten
4	Regulating wheel dresser	Dispositif de dressage pour meule d'entraînement	Regelscheibenabrichter
5	Regulating wheelhead	Poupée porte-meule d'entraînement	Regelscheibenspindelstock
6	Regulating wheel	Meule d'entraînement	Regelscheibe
7	Work support blade	Lame support de pièce	Werkstückauflagenstütze
8	Work rest	Appui porte-pièce	Werkstückauflage
9	Grinding wheel	Meule de travail	Schleifscheibe
10	Grinding wheelhead	Poupée porte-meule de travail	Schleifscheibenspindelstock
11	Grinding wheel dresser	Dispositif de dressage pour meule de travail	Schleifscheibenabrichter
12	Workpiece	Pièce	Werkstück

NOTE In addition to the terms used in the two official ISO languages (English and French) this International Standard gives the equivalent terms in German; these terms are published under the responsibility of the member body of Germany (DIN). However, only terms and definitions given in the official languages can be considered as ISO terms and definitions.

4 Preliminary remarks

4.1 Measuring units

In this International Standard, all linear dimensions, deviations and corresponding tolerances are expressed in millimetres; angular dimensions are expressed in degrees, and angular deviations and the corresponding tolerances are expressed in ratios, but in some cases microradians or arcseconds may be used for clarification purposes. The equivalence of the following expressions should always be kept in mind:

$$0{,}010 / 1\,000 = 10\ \mu\text{rad} \approx 2''$$

4.2 Reference to ISO 230-1 and ISO 230-2

To apply this International Standard, reference shall be made to ISO 230-1 and ISO 230-2, especially for the installation of the machine before testing, the warming up of spindles and other moving components, description of measuring methods and recommended accuracy of testing equipment.

In the "Observations" block of the tests described in Clauses 5 to 7, the instructions are preceded by a reference to the corresponding clause in ISO 230-1 and ISO 230-2 in cases where the test concerned is in compliance with the specifications of ISO 230-1 and ISO 230-2.

4.3 Testing sequence

The sequence in which the tests are presented in this International Standard in no way defines the practical order of testing. In order to make the mounting of instruments or gauging easier, tests may be performed in any order.

4.4 Tests to be performed

When testing a machine, it is not always necessary nor possible to carry out all the tests described in this International Standard. 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. The mere references to this International Standard 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.

4.5 Measuring instruments

The measuring instruments indicated in the tests described in Clauses 5 to 7 are examples only. Other instruments measuring the same quantities and having at least the same accuracy may be used. Dial gauges shall have a resolution of 0,001 mm.

4.6 Machining tests

Machining tests shall be made with finishing cuts only. Roughing cuts shall be avoided since they are liable to generate appreciable cutting forces.

4.7 Minimum tolerance

When establishing the tolerance for a measuring length different from that given in this International Standard (see 2.311 of ISO 230-1:1996), it shall be taken into consideration that the minimum value of tolerance is 0,002 mm.

5 Geometric tests

5.1 Grinding wheel dresser

Object **G1**

Checking of the dressing tool movement:

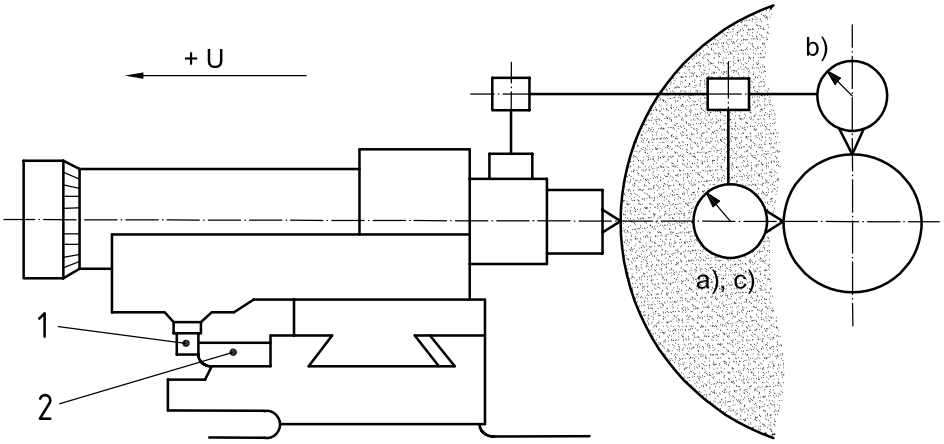
a) straightness in the plane of action;

b) parallelism to the grinding wheel spindle axis in a plane perpendicular to the plane of action;

c) parallelism to the grinding wheel spindle axis U in the plane of action.

NOTE Test c) applies only for machines with a fixed dresser and non-adjustable template.

Diagram



Key

1 copying pin

2 master template

Tolerance	**Measured deviation**
For a measuring length of 300	a)
a) 0,005 b) 0,10 c) 0,03	b)
	c)

Measuring instruments

Dial gauge, test mandrel and master template

Observations and references to ISO 230-1:1996 5.232.1 , 5.233.1 and 5.422.3

The dial gauges shall be mounted on the dressing tool holder with their styli contacting the test mandrel, which is mounted on the grinding wheel spindle, in the plane of action and in a plane perpendicular to the plane of action.

The dressing slide shall be moved in W-axis motion at a normal working feed. The measuring length shall be equal to the maximum width of the grinding wheel.

If the machine is provided with a copying mechanism, the copying pin shall be engaged with a normal working pressure (stated by the manufacturer) against the master template.

Indicated tolerance relates to the position of the diamond point.

The measuring method gives the sum of errors from the dressing mechanism.

5.2 Regulating wheel dresser

Object

G2

Checking of the dressing tool movement:

a) straightness in the plane of action;

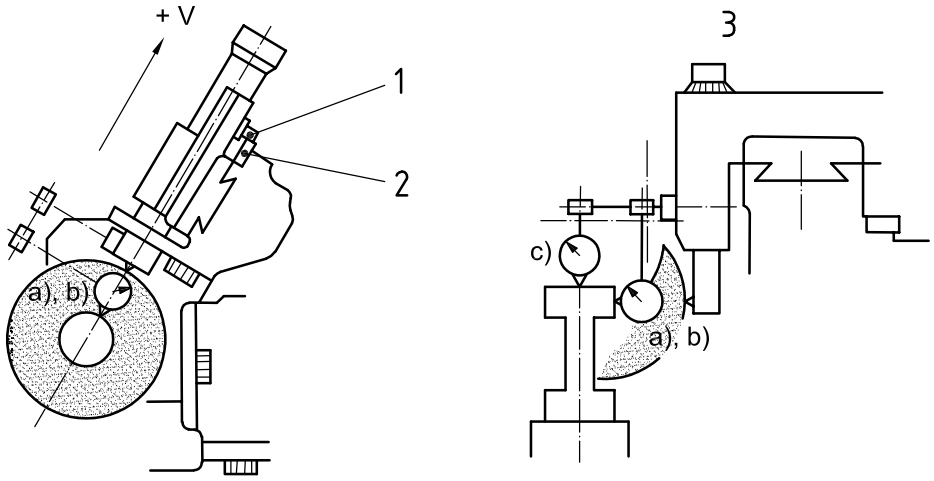
b) parallelism to the regulating wheel spindle axis in the plane of action;

c) parallelism to the work support plane.

NOTE 1 Test b) refers only to machines with a fixed dresser and non-adjustable template.

NOTE 2 Test c) refers only to machines with a non-gradient slide in the vertical plane.

Diagram



Key

1 copying pin
2 master template
3 alternative type of machine

Tolerance	**Measured deviation**
For a measuring length of 300	a)
a) 0,005 b) 0,03 c) 0,10	b)
	c)

Measuring instruments

Dial gauge, test mandrel, master template and test straightedge

Observations and references to ISO 230-1:1996 5.232.1, 5.233.1 and 5.422.3

The dial gauges shall be mounted on the dressing tool holder with their styli contacting the test mandrel or straightedge, which is mounted on the regulating wheel spindle, in the plane of action and in a plane perpendicular to the plane of action.

The dressing slide shall be moved at a normal working feed. The measuring length shall be equal to the maximum width of the regulating wheel.

If the machine is provided with a copying mechanism, the copying pin shall be engaged with a normal working pressure (stated by the manufacturer) against the master template.

The indicated tolerance relates to the position of the diamond point. The measuring method gives the sum of errors from the dressing mechanism.

5.3 Work support blade location

Object **G3**

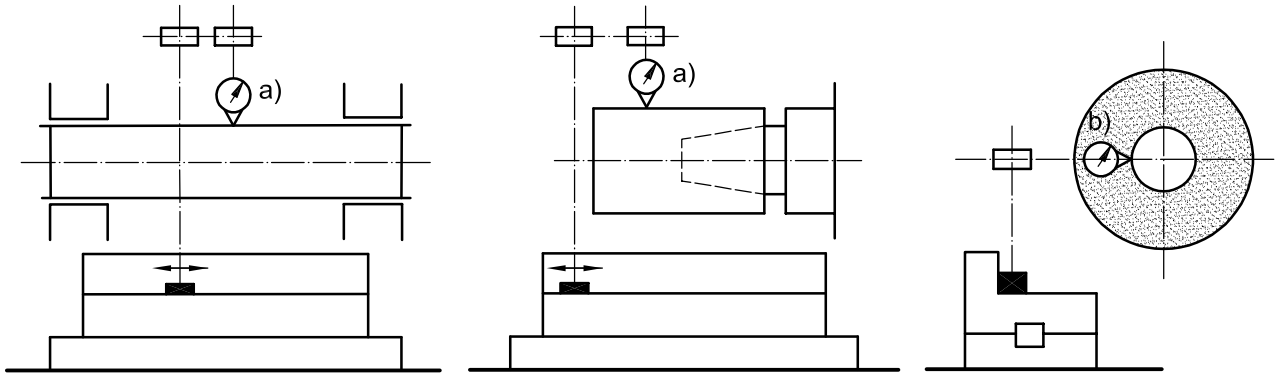
Checking of parallelism of:

a) the work support plane to the grinding wheel axis in the vertical plane;

b) the vertical datum face to the regulating wheel spindle in the horizontal plane.

NOTE Test b) applies only for machines with a fixed work support blade, fixed dresser and non-adjustable template.

Diagram



Tolerance	**Measured deviation**
For a measuring length of 300	a)
a) 0,05 b) 0,03	b)

Measuring instruments

Dial gauge, test mandrel

Observations and references to ISO 230-1:1996 5.412.1 and 5.412.4

The dial gauge shall be mounted on the work-support-blade location surfaces, with the stylus contacting the test mandrel.

5.4 Grinding wheel spindle

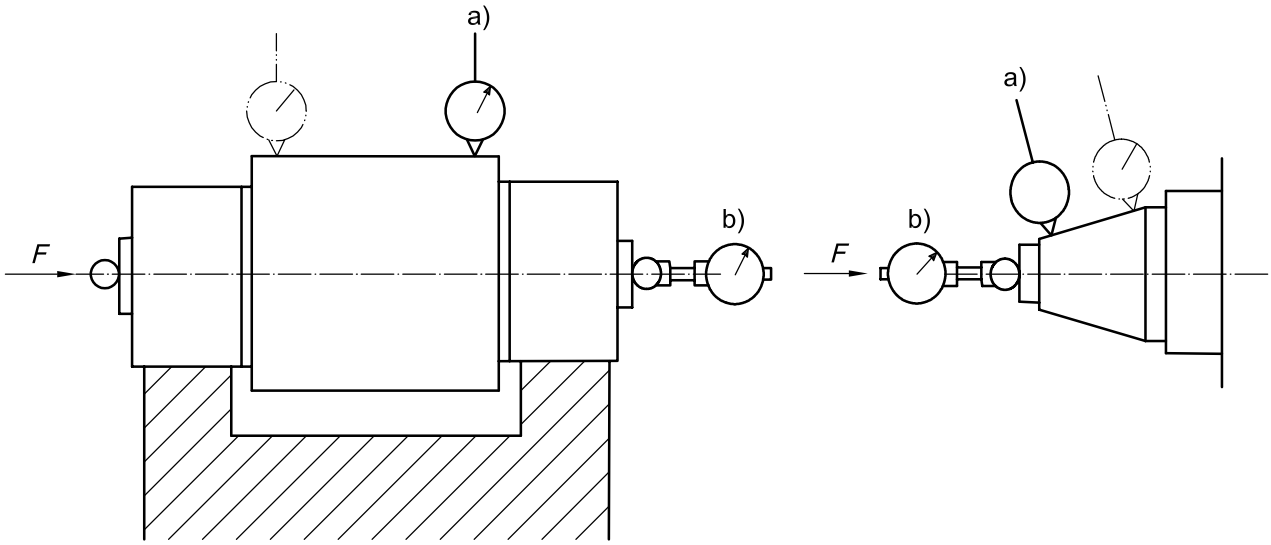
Object **G4**

Checking of the grinding wheel spindle:

a) run-out (at the wheel mounting diameter/taper);

b) periodic axial slip.

Diagram



Tolerance	Measured deviation
a) 0,005 for the two locations touched	a)
b) 0,008	b)

Measuring instruments

Dial gauge

Observations and references to ISO 230-1:1996

a) 5.612.2

The stylus of the dial gauge shall be set normal to the surface to be checked.

The measurement of run-out shall be carried out at both ends of the conical or cylindrical grinding wheel mounting surface.

b) 5.622.1 and 5.622.2

The value and the direction of the axial force F to be applied shall be specified by the supplier/ manufacturer.

When preloaded bearings are used, there is no need to apply the force F.

5.5 Regulating wheel spindle

Object

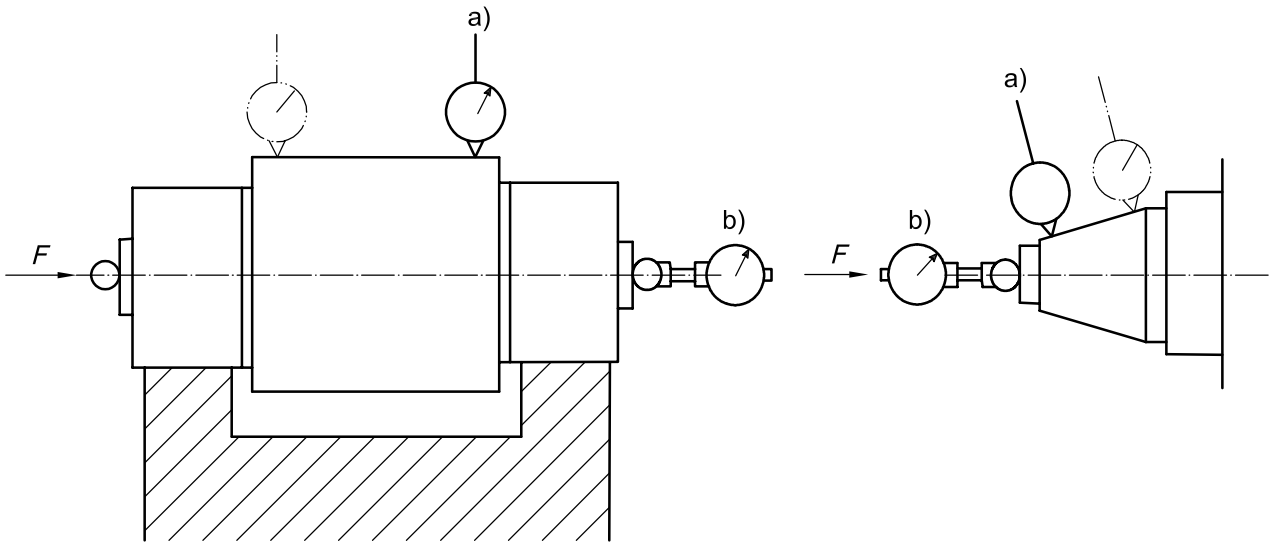
G5

Checking of the regulating wheel spindle:

a) run-out (at the wheel mounting diameter);

b) periodic axial slip.

Diagram



Tolerance	**Measured deviation**
a) 0,005 for the two locations touched	a)
b) 0,01	b)

Measuring instruments

Dial gauge

Observations and references to ISO 230-1:1996

a) 5.612.2

The stylus of the dial gauge shall be set normal to the surface to be checked.

The measurement of run-out shall be carried out at both ends of the conical or cylindrical regulating wheel mounting surface.

b) 5.622.1 and 5.622.2

The value and the direction of the axial force F to be applied shall be specified by the supplier/ manufacturer of the machine.

When preloaded bearings are used, there is no need to apply the force F.

6 Machining tests

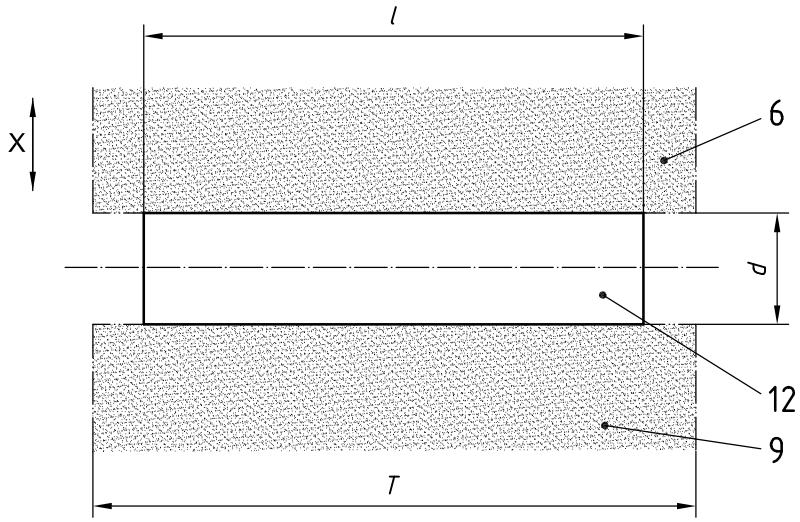
Object **M1**

Checking of the accuracy of an in-feed ground cylindrical test piece for:

a) circularity;

b) consistency of diameters.

Diagram



T	d	l
$T \leqslant 100$	15	$0{,}6T \leqslant l \leqslant 0{,}9T$
$100 < T \leqslant 200$	20	
$T > 200$	30	

NOTE For the reference number of components, refer to Figure 1.

Material: steel

Tolerance		**Measured deviation**
a) 0,002	b) 0,002 for $T \leqslant 100$ 0,003 for $100 < T \leqslant 200$ 0,004 for $200 < T \leqslant 300$ 0,005 for $300 < T$	For $T =$ .... a) b)

Measuring instruments

Roundness measuring instrument and micrometer

Observations and references to ISO 230-1:1996 4.1 and 4.2

The test for circularity should be made at several positions of the test piece and the greatest value of the deviation should be reported.

The measurement for consistency of diameter shall be carried out in a single axial plane.

Object

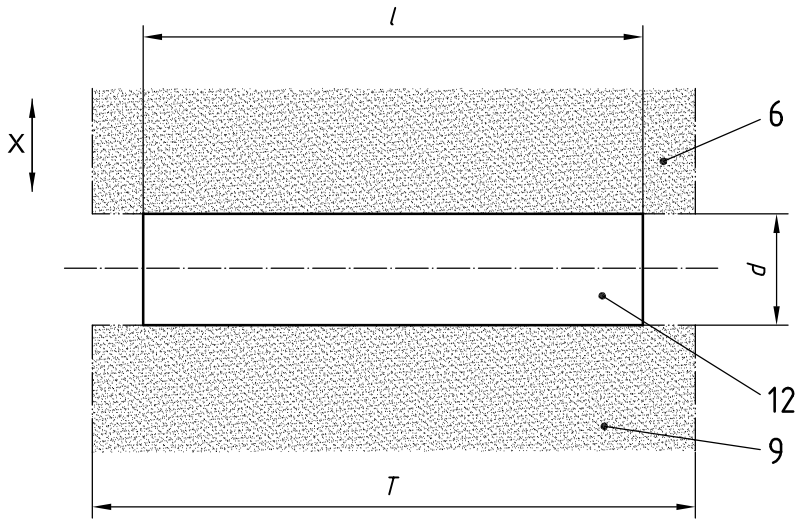
M2

Checking of the accuracy of a through-feed ground cylindrical test piece for:

a) circularity;

b) consistency of diameters.

Diagram



T	d	l
$T \leqslant 100$	15	$0{,}3T \leqslant l \leqslant 0{,}5T$
$100 < T \leqslant 200$	20	
$T > 200$	30	

NOTE For the reference number of components, refer to Figure 1.

Material: steel

Tolerance

a) 0,002 for $T \leqslant 200$
0,003 for $200 < T \leqslant 500$

b) 0,002 for $T \leqslant 200$
0,003 for $200 < T \leqslant 500$

Measured deviation

For T = ...

a)

b)

Measuring instruments

Roundness measuring instrument and micrometer

Observations and references to ISO 230-1:1996 4.1 and 4.2

The test for circularity should be made at several positions of the test piece and the greatest value of the deviation should be reported.

The measurement for consistency of diameter shall be carried out in a single axial plane.

7 Accuracy and repeatability of positioning

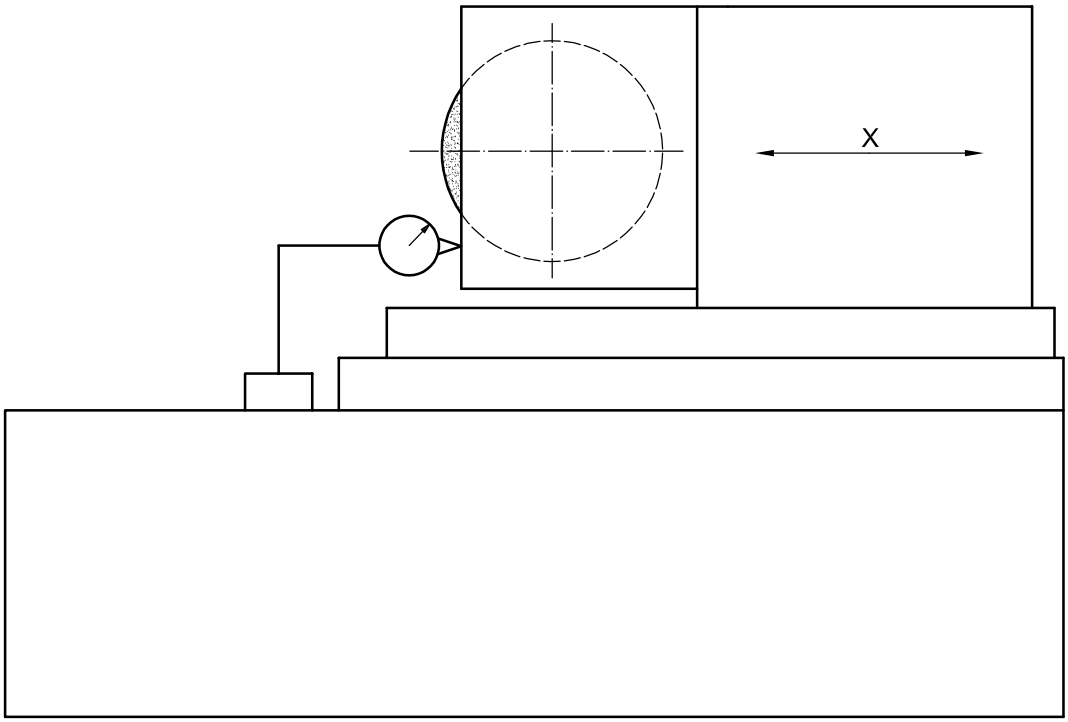
7.1 Positioning of manual or automatic (but not numerically controlled) linear axes

Object **P1**

Checking of repeatability of the final approach of the wheelhead positioning.

NOTE This test applies only to machines equipped for infeed grinding operations.

Diagram



Tolerance	**Measured deviation**
0,002	

Measuring instruments

Dial gauge

Observations and references to ISO 230-1

Carry out five consecutive tests for the wheelhead positioning, the movement being obtained by a fast approach followed by a slow approach.

A range of five readings shall be recorded.

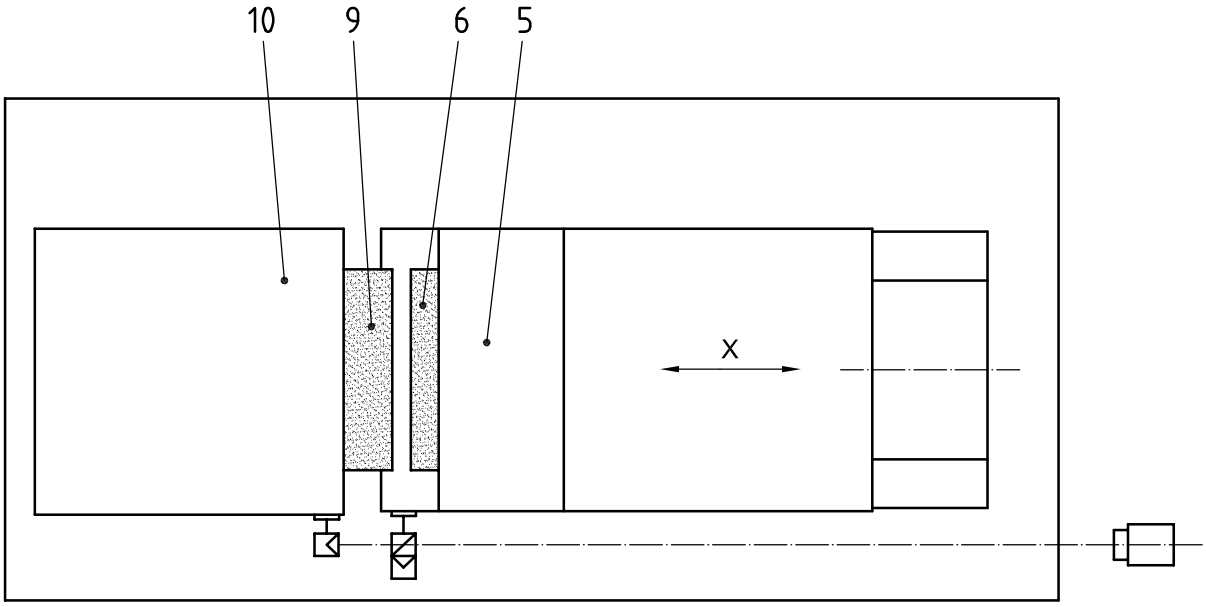
7.2 Positioning of numerically controlled linear axes

Object

Checking of unidirectional accuracy and repeatability of the X-axis movement of the wheelhead by numerical control.

P2

Diagram



NOTE For the reference number of components, refer to Figure 1.

Tolerance		Measuring length ⩽ 200	**Measured deviation**
Unidirectional accuracy of positioning of an axis	A ↑	0,016	
Unidirectional repeatability of positioning of an axis	R ↑	0,006	
Unidirectional systematic deviation of an axis	E ↑	0,008	

Measuring instruments

Linear gauge, laser measurement equipment, or linear scale

Observations and references to ISO 230-2

Relative measurement between tool position and workpiece position is required.

Clauses 3, 4 and 7 of ISO 230-2:1997 shall be taken into account regarding the test conditions, test program, and presentation of the results.

Object

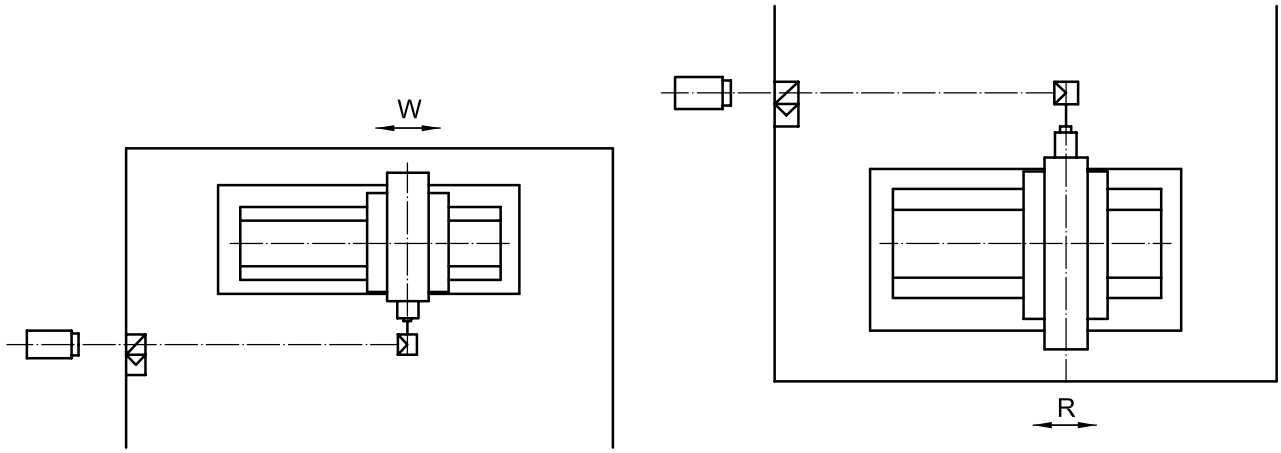
P3

Checking of positioning accuracy and repeatability of

a) the W-axis movement of the grinding wheel dressing tool under numerical control,

b) the R-axis movement of the regulating wheel dressing tool under numerical control.

Diagram



a) b)

Tolerance

		Measuring length		Measured deviation	
		⩽ 500	⩽ 1 000	W	R
Unidirectional accuracy of positioning of an axis	A ↑	0,016	0,020		
Unidirectional repeatability of positioning of an axis	R ↑ and R ↓	0,008	0,010		
Bidirectional systematic positional deviation of an axis	E	0,016	0,020		
Unidirectional systematic positional deviation of an axis	E ↑ and E ↓	0,008	0,010		
Range of the mean bidirectional positional deviation of an axis	M	0,008	0,010		

Measuring instruments

Linear scale or laser measurement equipment

Observations and references to ISO 230-1 and ISO 230-2

The measurements can be done prior to installing in the machine, if the dressing tool movement is the same before and after installation.

Clauses 3, 4 and 7 of ISO 230-2:1997 shall be taken into account regarding the test conditions, test program and the presentation of the results.

NOTE Although normally these measurements should be done between the grinding wheel dresser and the grinding wheel a), respectively between the regulating wheel dresser and the regulating wheel b) of the machine due to fixturing difficulties, diagrams show compromise in placing the optics.

Object

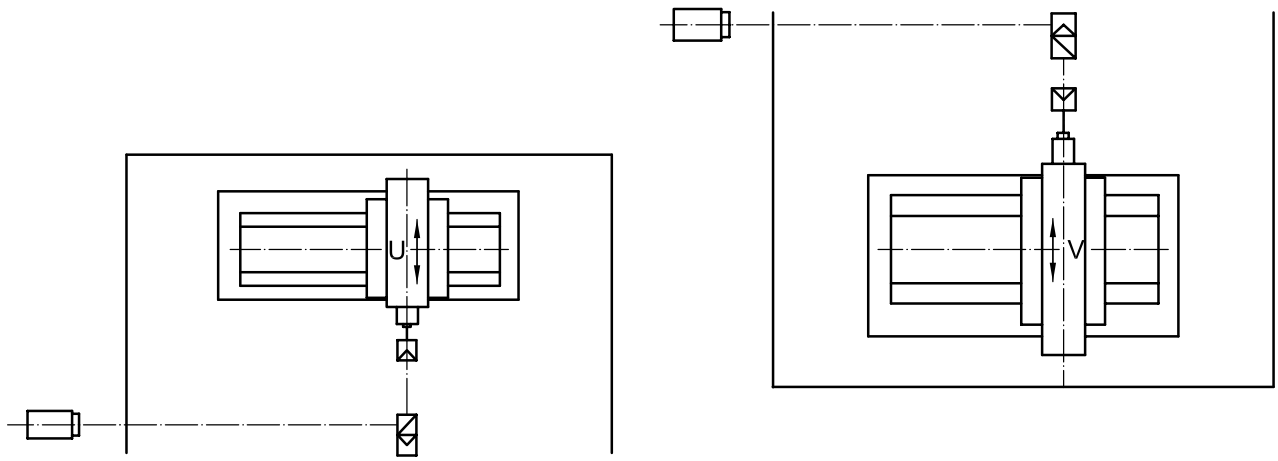
P4

Checking of unidirectional accuracy and repeatability of

a) the U-axis movement of the grinding wheel dressing tool under numerical control,

b) the V-axis movement of the regulating wheel dressing tool under numerical control.

Diagram



a) b)

Tolerance			**Measured deviation**	
		Measuring length $\leqslant$ 200	U	V
Unidirectional accuracy of positioning of an axis	A ↑	0,016		
Unidirectional repeatability of positioning of an axis	R ↑	0,006		
Unidirectional systematic positional deviation of an axis	E ↑	0,008		

Measuring instruments

Digital linear gauge, laser measurement equipment, or standard scale and scale reader

Observations and references to ISO 230-2

Clauses 3, 4 and 7 of ISO 230-2:1997 shall be taken into account regarding the test conditions, test program and the presentation of the results.

NOTE Although normally these measurements should be done between the grinding wheel dressing tool and the grinding wheel a), respectively between the regulating wheel dressing tool and the regulating wheel b) of the machine due to fixturing difficulties, diagrams show compromise in placing the optics.

Bibliography

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

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