INTERNATIONAL STANDARD

ISO 11090-1

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Machine tools — Test conditions for die sinking electro-discharge machines (EDM) — Terminology and testing of accuracy —

Part 1:
Single column machines (cross slide table type and fixed table type)

Machines-outils — Conditions d'essai des machines d'électroérosion en plongée — Terminologie et contrôle de la précision —

Partie 1: Machines à un montant (à bancs en croix et table fixe)

Reference number
ISO 11090-1:1998(E)

Contents

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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.

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.

International Standard ISO 11090-1 was prepared by Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 2, *Test conditions for metal cutting machine tools*.

ISO 11090 consists of the following parts, under the general title *Machine tools — Test conditions for die sinking electro-discharge machines (EDM) — Terminology and testing of accuracy*:

— *Part 1: Single column machines (cross slide table type and fixed table type)*

— *Part 2: Two column machines (slide head type and cross slide table type)*

Annexes A and B of this part of ISO 11090 are for information only.

Introduction

The purpose of ISO 11090 is to standardize methods of testing the accuracy of die sinking electro-discharge machines (EDM).

Machine tools — Test conditions for die sinking electro-discharge machines (EDM) — Terminology and testing of accuracy —

Part 1:
Single column machines (cross slide table type and fixed table type)

1 Scope

This part of ISO 11090 specifies, with reference to ISO 230-1 and ISO 230-2, geometric and machining tests and tests for checking accuracy and repeatability of numerically controlled positioning axes for general purpose and normal accuracy die sinking electro-discharge machines (EDM). It also specifies the applicable tolerances corresponding to the above-mentioned tests.

This part of ISO 11090 is applicable to single column machines of cross slide table type and fixed table type.

This part of ISO 11090 deals only with the verification of the accuracy of the machine. It does not apply to the testing of the machine operation (vibrations, abnormal noises, stick-slip motion of components, etc.), nor to the checking of its characteristics (such as speeds, feeds, etc.), which should generally be checked before the testing of accuracy.

This part of ISO 11090 provides the terminology used for the principal components of the machine and the designation of the axes with reference to ISO 841.

NOTE — In addition to the terms used in the three official ISO languages (English, French and Russian), annex A of this part of ISO 11090 gives the equivalent terms in the Dutch, German, Italian and Swedish languages; these are published under the responsibility of the National member bodies for Belgium (IBN), Germany (DIN), Italy (UNI) and Sweden (SIS). However, only the terms given in the official languages can be considered as ISO terms.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 11090. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 11090 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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 of numerically controlled axes.*

3 Terminology and designation of axes

3.1 Cross slide table type

See figure 1 and table 1.

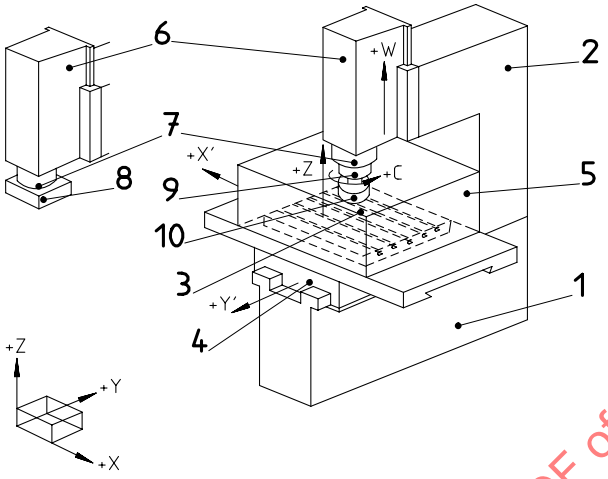


Figure 1 — Single column machine with cross slide table

Table 1 — Terminology

Ref.	English	French	Russian
1	Bed	Banc	Станина
2	Column	Montant	Стойка
3	Table (X-axis)	Table (axe X)	Стол (ось X)
4	Saddle (Y-axis)	Chariot transversal (axe Y)	Салазки (ось Y)
5	Work tank	Réservoir de travail	Рабочая ванна
6	Head (W-axis)	Tête de travail (axe W)	Головка, рабочая (ось W)
7	Quill (Z-axis)	Coulisse (axe Z)	Пиноль (ось Z)
8	Electrode platen	Porte-électrode	Электрододержатель
9	Spindle (C-axis)	Broche (axe C)	Шпиндель (ось C)
10	Electrode	Électrode	Электрод

3.2 Fixed table type

See figure 2 and table 2.

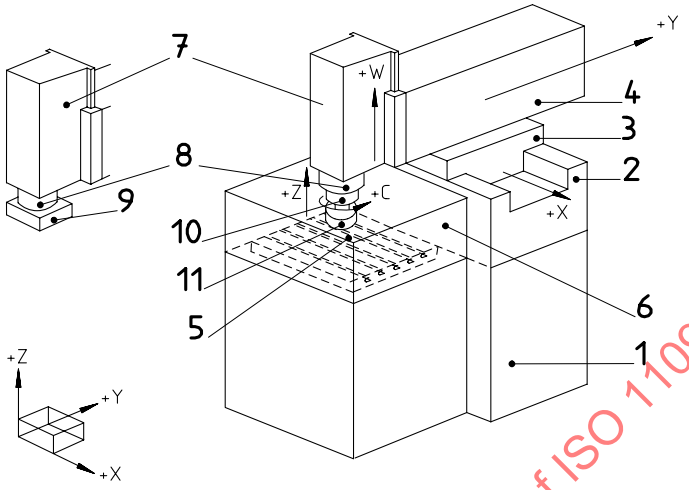


Figure 2 — Single column machine with fixed table

Table 2 — Terminology

Ref.	English	French	Russian
1	Bed	Banc	Станина
2	Column	Montant	Стойка
3	Saddle (X-axis)	Chariot longitudinal (axe X)	Салазки (ось X)
4	Ram (Y-axis)	Coulant (axe Y)	Ползун (ось Y)
5	Table	Table	Стол
6	Work tank	Réservoir de travail	Рабочая ванна
7	Head (W-axis)	Tête de travail (axe W)	Головка, рабочая (ось W)
8	Quill (Z-axis)	Coulisse (axe Z)	Пиноль (ось Z)
9	Electrode platen	Porte-électrode	Электродержатель
10	Spindle (C-axis)	Broche (axe C)	Шпиндель (ось C)
11	Electrode	Électrode	Электрод

4 Preliminary remarks

4.1 Measuring units

In this part of ISO 11090, all linear dimensions, deviations and corresponding tolerances are expressed in millimeters; 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:

$$0{,}010/1\ 000 = 10 \times 10^{-6} = 10\ \mu\text{rad} \approx 2''$$

4.2 Reference to ISO 230-1

To apply this part of ISO 11090, reference shall be made to ISO 230-1, especially for the installation of the machine before testing, warming up of the spindle and other moving components, description of measuring methods and recommended accuracy of testing equipment.

In the «Observations» block of the tests described in the following sections, the instructions are followed by a reference to the corresponding clause in ISO 230-1 in cases where the test concerned is in compliance with the specifications of that part of ISO 230.

4.3 Testing sequence

The sequence in which the tests are presented in this part of ISO 11090 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 or possible to carry out all the tests described in this part of ISO 11090. 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 11090 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 the following sections 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 millimeters or better.

4.6 Machining tests

Machining tests shall be made with finishing cuts only, not with roughing cuts which 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 part of ISO 11090 (see 2.311 of ISO 230-1:1996), it shall be taken into consideration that the minimum value of tolerance is 0,005 mm.

4.8 Positioning tests and reference to ISO 230-2

Tests P2 to P5 are only applied to numerically controlled electro-discharge machines.

To apply these tests, reference should be made to ISO 230-2, especially for the environmental conditions, warming up of the machine, measuring methods, evaluation and interpretation of the results.

Checking of the W-axis is not included because the W movement is used for adjusting the head position. When required, it shall be done in the same way as the checking of the Z-axis.

5 Geometric tests

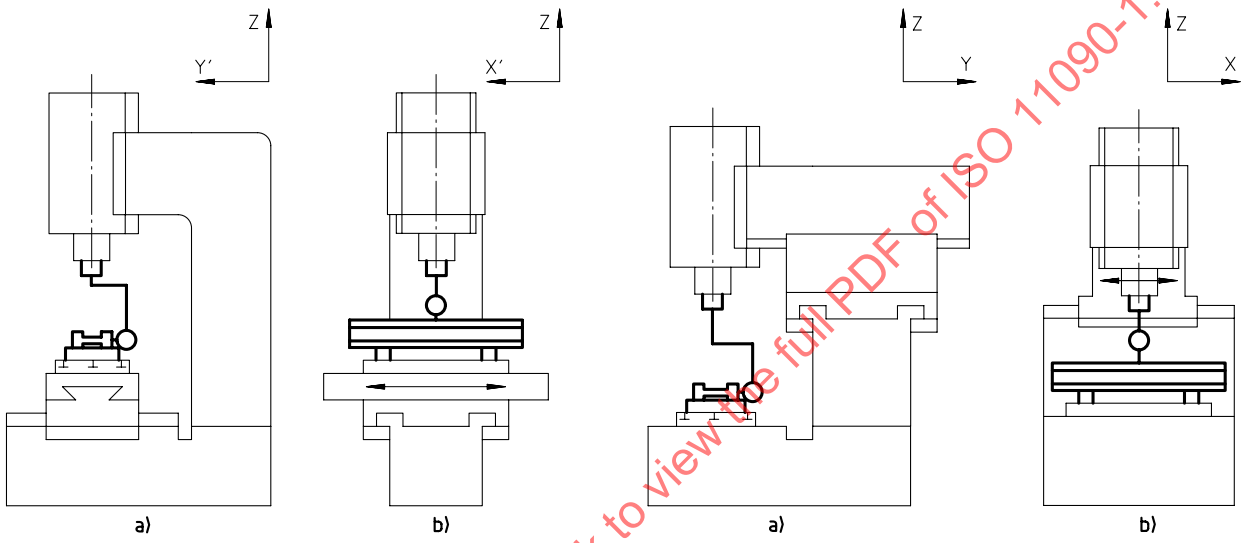
5.1 Linear axes of motion

Object **G1**

Checking of straightness of the X-axis motion:

a) in the horizontal XY plane
b) in the vertical ZX plane

Diagram



Tolerance	**Measured deviation**
for a) and b) 0,015 for any measuring length of 500	a) b)

Measuring instruments

Straightedge, dial gauge and gauge blocks, or optical methods

Observations and references to ISO 230-1 5.232.11

Mount the dial gauge on the head.

a) Set the straightedge parallel to the X-axis in the XY plane, and set the dial gauge against it. Feed the X-axis motion through the measuring length, and note the readings.

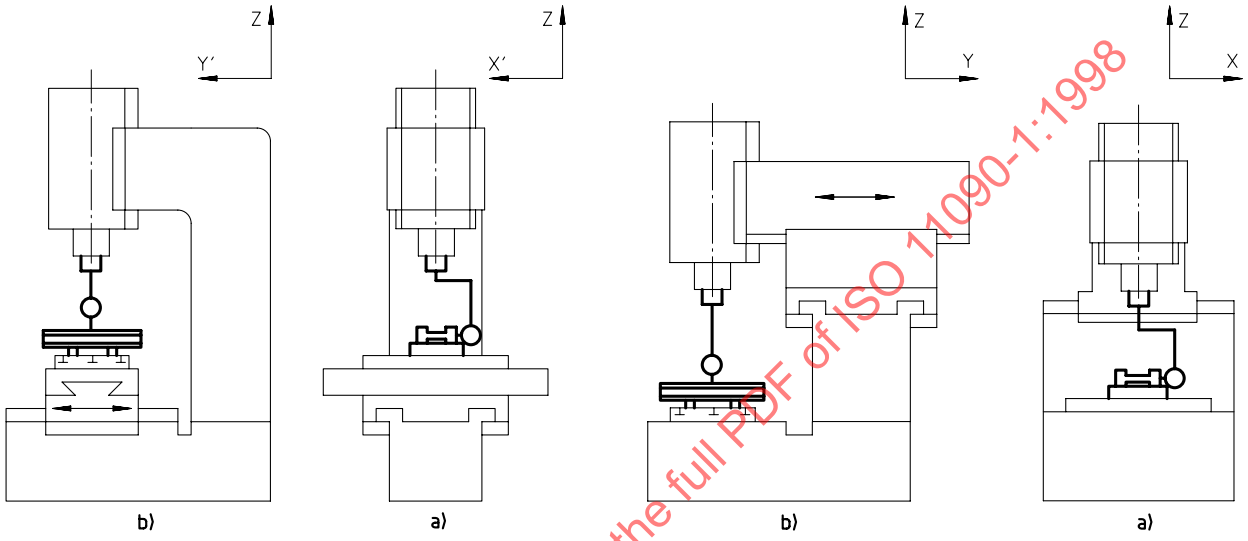
b) Repeat the check in the same way in the ZX plane.

Object **G2**

Checking of straightness of the Y-axis motion:

a) in the horizontal XY plane;
b) in the vertical YZ plane.

Diagram



Tolerance	**Measured deviation**
for a) and b) 0,015 for any measuring length of 500	a) b)

Measuring instruments

Straightedge, dial gauge and gauge blocks, or optical methods

Observations and references to ISO 230-1 5.232.11

Mount the dial gauge on the head.

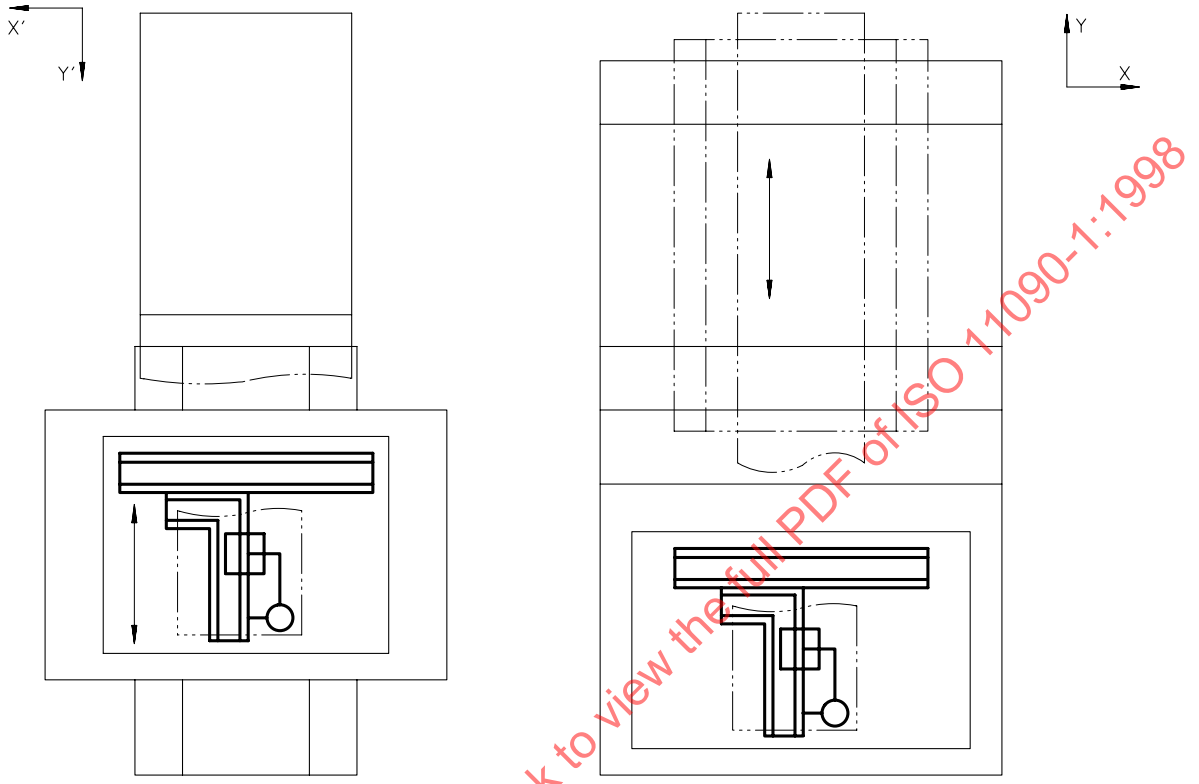
a) Set the straightedge parallel to the Y-axis in the XY plane, and set the dial gauge against it. Feed the Y-axis motion through the measuring length, and note the readings.

b) Repeat the check in the same way in the YZ plane.

Object **G3**

Checking of squareness between the X-axis motion and the Y-axis motion.

Diagram



Tolerance	**Measured deviation**
0,015 for any measuring length of 300	

Measuring instruments

Straightedge, square and dial gauge

Observations and references to ISO 230-1 5.522.4

Align the straightedge on the table so as to be parallel to the X-axis motion, and press the square against it.

Mount the dial gauge on the head, and set it against the square. Feed the Y-axis motion through the measuring length, and note the reading.

Using the square only is also possible. In this case

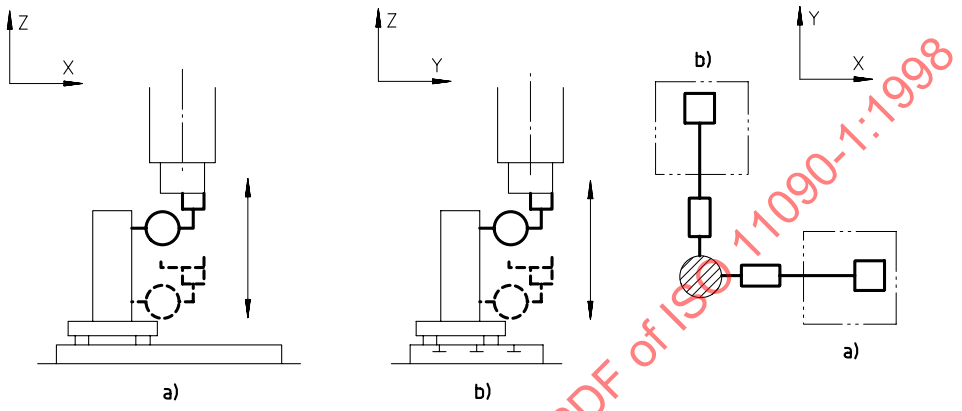
a) set the square so that the long arm is parallel to the X-axis motion,
b) check the parallelism of the Y-axis motion with the short arm.

Object **G4**

Checking of squareness between the vertical movement of the quill (Z-axis) and:

a) the X-axis motion;
b) the Y-axis motion.

Diagram



Tolerance	**Measured deviation**
for a) and b) 0,02 for any measuring length of 300	a) b)

Measuring instruments

Cylindrical square, surface plate, adjustable blocks and dial gauge

Observations and references to ISO 230-1 5.522.4

Mount the surface plate on the table and adjust it so that the surface is parallel to both the X and Y axes. Place the cylindrical square on the surface plate. Mount the dial gauge on the head.

a) Set the dial gauge against the cylindrical square in the X-direction. Move the quill in the Z-direction through the measuring length, and note the readings at several positions. The maximum difference of the readings shall not exceed the tolerance.

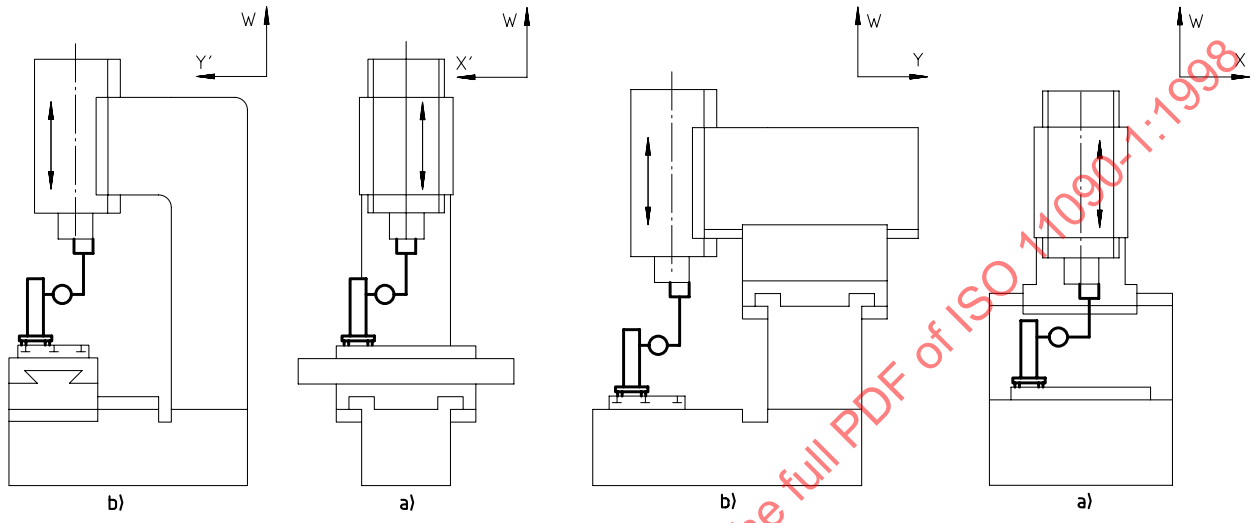
b) Repeat the check in the same way in the Y-direction.

Object **G5**

Checking of the squareness between the vertical movement of the head (W-axis) and:

a) the X-axis motion;
b) the Y-axis motion.

Diagram



Tolerance	**Measured deviation**
for a) and b) 0,015 for any measuring length of 300	a) b)

Measuring instruments

Cylindrical square, surface plate, adjustable blocks and dial gauge

Observations and references to ISO 230-1 5.522.4

Mount the surface plate on the table and adjust it so that the surface is parallel to both the X and Y axes. Place the cylindrical square on the surface plate. Mount the dial gauge on the head.

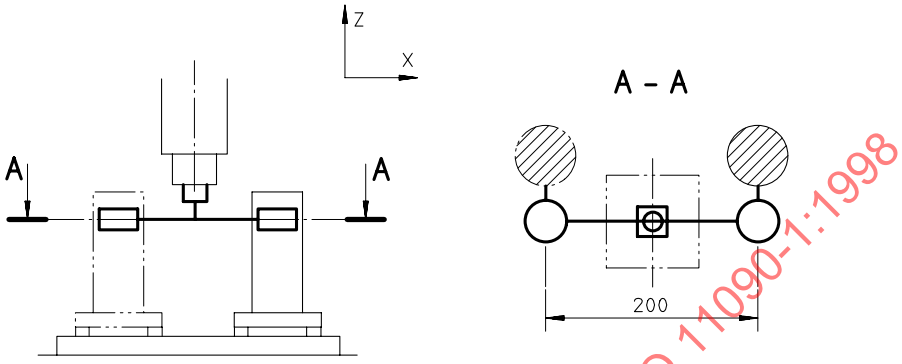
a) Set the dial gauge against the cylindrical square in the X-direction. Move the head in the W-direction through the measuring length, and note the readings at several positions. The maximum difference of the readings shall not exceed the tolerance.

b) Repeat the check in the same way in the Y-direction.

Object **G6**

Checking of roll of the quill during the Z-axis motion.

Diagram



Tolerance	**Measured deviation**
0,04/200 for any measuring length of 300	

Measuring instruments

Dial gauge and cylindrical square

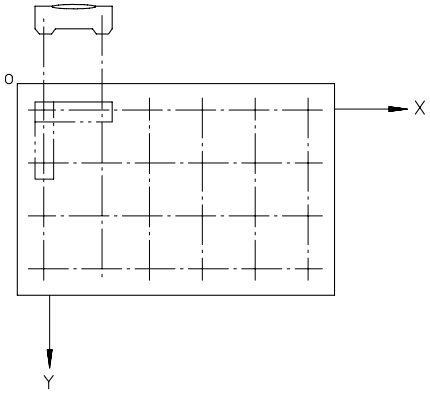
Observations and references to ISO 230-1 5.231.3

Place a cylindrical square on the table, approximately parallel to the Y-axis, and set the stylus of a dial gauge mounted on a special arm against the square. Note the readings and mark the corresponding heights on the square. Move the dial gauge to the other side of the quill and move the X-axis, so that the stylus again touches the cylinder square along the same line. The possible roll deviation of the X-axis motion shall be measured and taken into account. The dial gauge shall be zeroed again and the new measurements shall be taken at the same heights of the previous ones, and noted. For each measurement height calculate the difference of the two readings. The maximum and the minimum of these differences shall be selected, and the value given by

$$\frac{\text{maximum difference} - \text{minimum difference}}{d}$$

where d is the distance between the two positions of the dial gauge, shall not exceed the tolerance.

5.2 Table

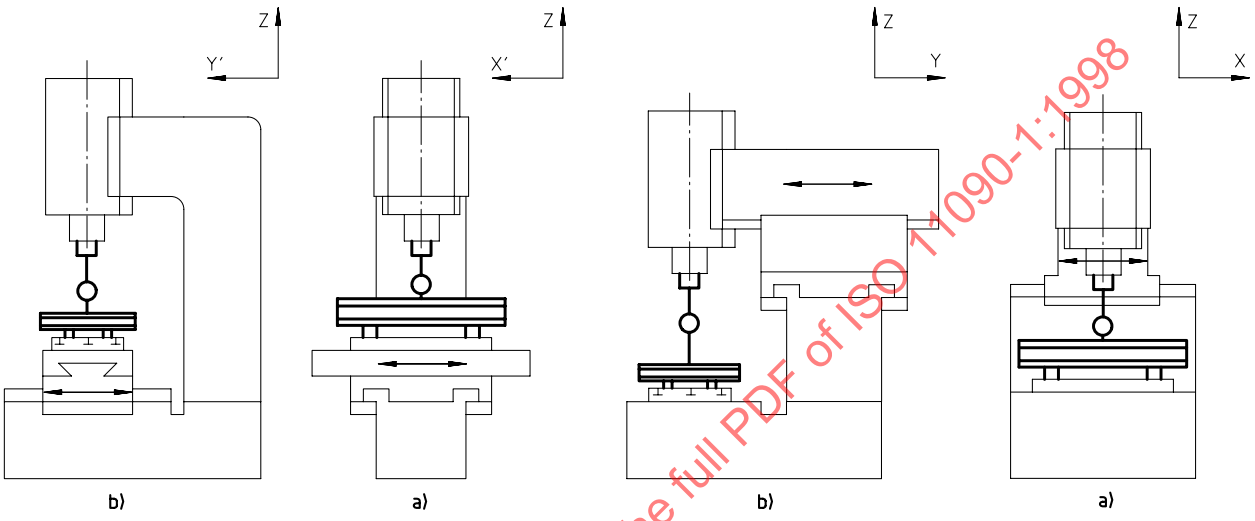
Object	**G7**
Checking of flatness of the table surface.	
Diagram  	
Tolerance 0,03 for a measuring length up to 1 000; add 0,01 for any further 1 000 increase in length NOTE — Measuring length means the longer length of O-X and O-Y	**Measured deviation**
Measuring instruments Precision level or straightedge, gauge blocks and dial gauge, or optical or other equipment	
Observations and references to ISO 230-1 5.322, 5.324 Place the precision level on the table surface, displace it in directions O-X and O-Y in steps corresponding to its length in the direction concerned, and note the readings. Record and evaluate the values obtained for each step.	

Object **G8**

Checking of parallelism between the table surface and:

a) the X-axis motion;
b) the Y-axis motion.

Diagram



Tolerance	**Measured deviation**
for a) and b) 0,015 for any measuring length of 300 Maximum tolerance: 0,04	a) b)

Measuring instruments

Dial gauge, straightedge and gauge blocks

Observations and references to ISO 230-1 5.422.21 and 5.422.22

Mount the dial gauge on the head.

a) Set the straightedge on the blocks in the X-direction, move the X-axis through the measuring length, and note the reading.

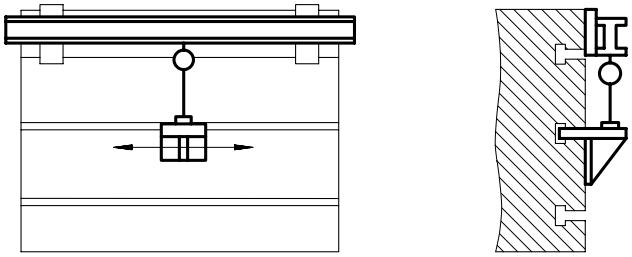
b) Repeat the check in the same way in the Y-direction.

Direct measurement of the table surface without using the straightedge can also be applicable.

Object **G9**

Checking of straightness of the reference T-slot or reference surface of the table in the X-direction.

Diagram



Tolerance	**Measured deviation**
0,02 for any measuring length of 500 Maximum tolerance: 0,05	

Measuring instruments

Straightedge, dial gauge and cross square, or optical or other equipment

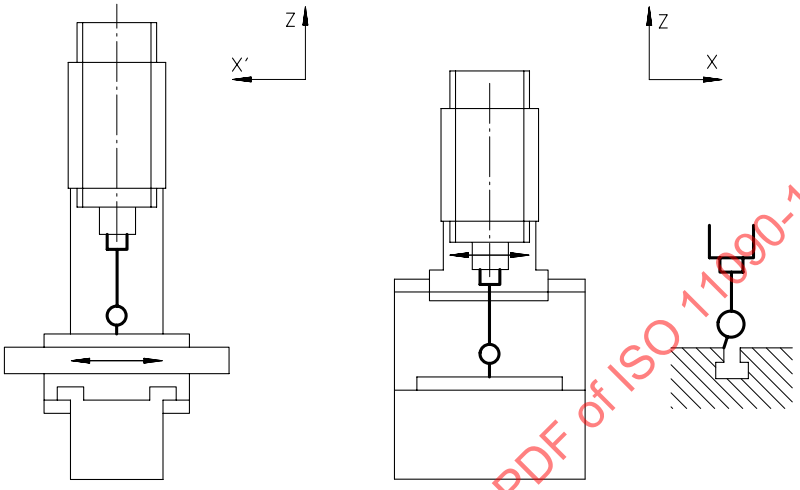
Observations and references to ISO 230-1 5.212 and 5.212.1

Place the straightedge on the table surface and align it parallel to the reference slot or reference surface. Attach the dial gauge support to the cross square, and set it against the straightedge. Move the cross square along the reference slot or reference surface in the X-direction and note the readings.

Object **G10**

Checking of parallelism between the reference T-slot or reference surface of the table and the X-axis motion.

Diagram



Tolerance	**Measured deviation**
0,015 for any measuring length of 300 Maximum tolerance: 0,04	

Measuring instruments

Dial gauge

Observations and references to ISO 230-1 5.422.21 and 5.422.22

Mount the dial gauge on the head. Set the dial gauge against the reference slot or reference surface. Feed the X-axis through the measuring length and note the reading.

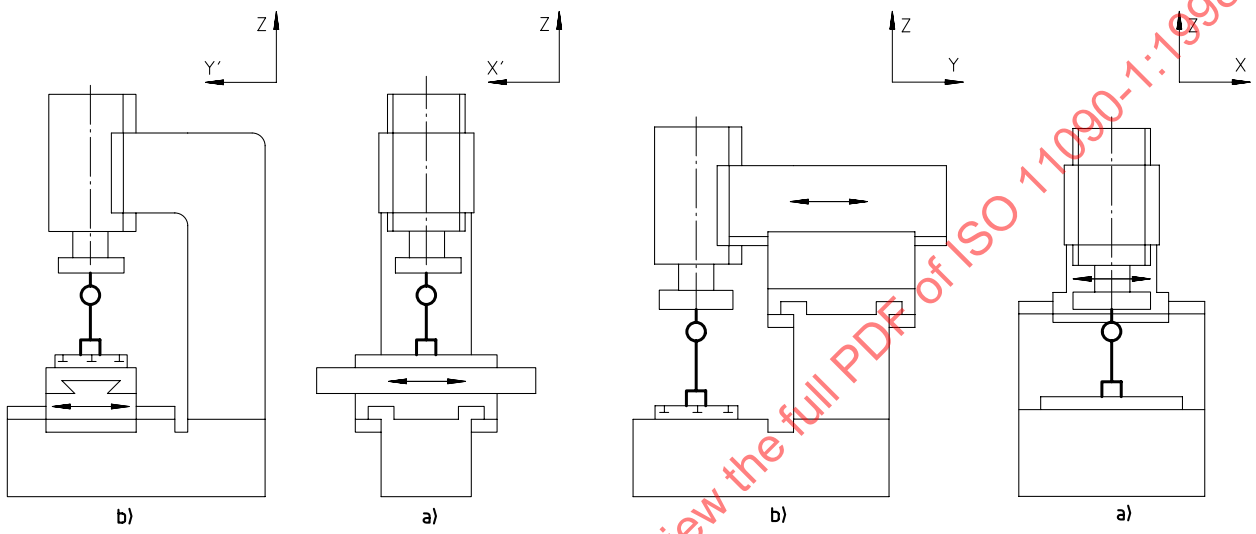
5.3 Head, quill and spindle

Object **G11**

Checking of parallelism between the electrode platen and:

a) the X-axis motion;
b) the Y-axis motion.

Diagram



Tolerance	**Measured deviation**
for a) and b) 0,015 for any measuring length of 200	a) b)

Measuring instruments

Dial gauge

Observations and references to ISO 230-1 5.422.21 and 5.422.22

Place the dial gauge on the table.

Set the dial gauge against the electrode platen surface.

a) Feed the X-axis through the measuring length, and note the readings at several positions. The maximum difference of the readings shall not exceed the tolerance.

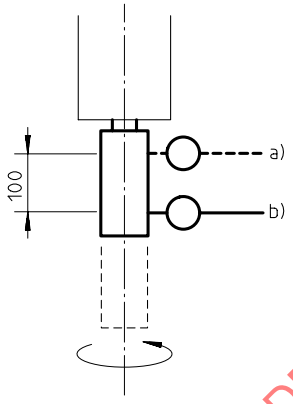
b) Repeat the check in the same way in the Y-direction.

Object **G12**

Checking of run-out of the spindle bore

a) near the spindle nose;
b) at a distance of 100 mm.

Diagram



Tolerance		**Measured deviation**
a) 0,005	b) 0,01	a) b)

Measuring instruments

Test mandrel and dial gauge

Observations and references to ISO 230-1 5.612.3

Attach the test mandrel to the spindle.

Mount the dial gauge on a fixed component of the machine.

a) Set the dial gauge against the test mandrel near the spindle nose, turn the spindle and note the reading.

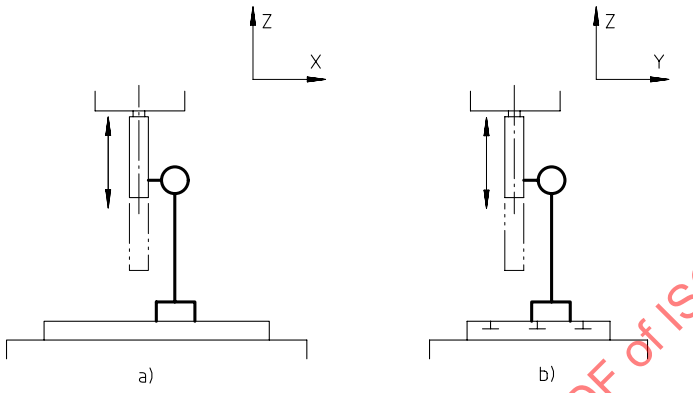
b) Repeat the check in the same way at a distance of 100 mm apart.

Object **G13**

Checking of parallelism between the spindle axis and the Z-axis motion:

a) in the ZX plane;
b) in the YZ plane.

Diagram



Tolerance	**Measured deviation**
for a) and b) 0,01 for any measuring length of 100	a) b)

Measuring instruments

Test mandrel and dial gauge

Observations and references to ISO 230-1 5.412.1 and 5.422.3

Mount the dial gauge on a fixed component of the machine.

a) Set the dial gauge against the test mandrel in the ZX plane, find the mean position of the spindle by rotating the spindle. Move the quill in the Z-direction and note the readings at several positions. The maximum difference of the readings shall not exceed the tolerance.

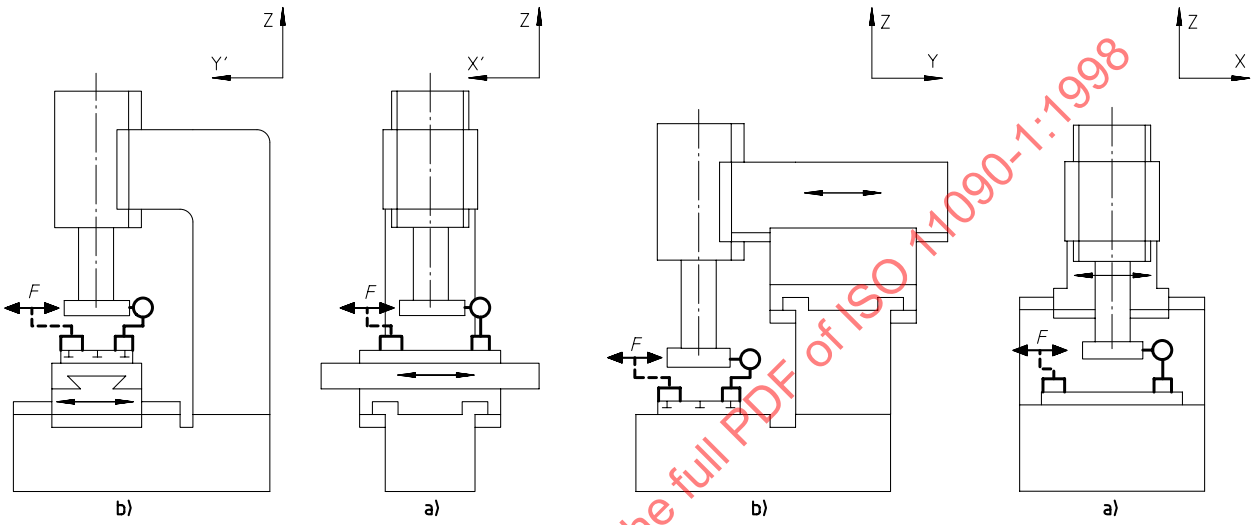
b) Repeat the check in the same way in the YZ plane.

Object **G14**

Checking of the overall backlash between the quill and the table:

a) in the X-direction;
b) in the Y-direction.

Diagram



Tolerance

for a) and b)
0,04 for force *F*

NOTE — *F* is 10 % of the allowed maximum electrode weight and is limited to 100 N; it should be stated by the supplier/manufacturer.

Measured deviation

a)
b)

Measuring instruments

Dial gauge and load cell, or spring balance

Observations and references to ISO 230-1

Position the X and Y axes to their middle position.

Extend the quill to the maximum, and mount the dial gauge on the table.

a) Set the dial gauge against the electrode platen in the X-direction. Apply the force *F* from the table to the electrode platen from the opposite side of the dial gauge and note the reading; then apply the same force from the same side of the dial gauge and note the reading. Take the difference of the above readings as the measured result.

b) Repeat the check in the same way in the Y-direction.

6 Positioning tests

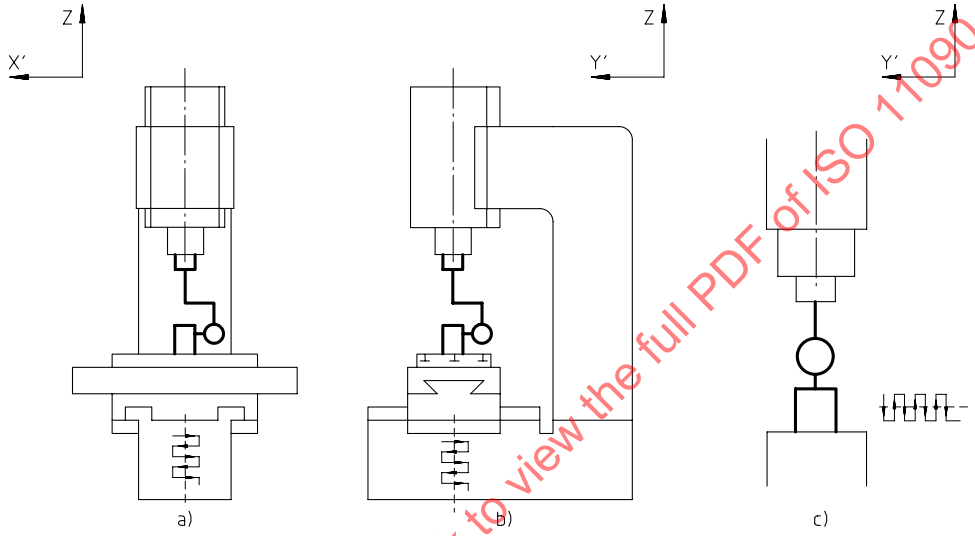
6.1 Manually operated axes

Object **P1**

Checking of backlash in the axes feed mechanism:

a) in the X-axis;
b) in the Y-axis;
c) in the Z-axis.

Diagram



Tolerance	**Measured deviation**
for a), b) and c) 0,03	a) b) c)

Measuring instruments

Dial gauge and block

Observations and references to ISO 230-1

Mount the dial gauge on the quill end or electrode platen and mount the block on the table so that the dial gauge can be set against the block by the table feed a) in the X-direction.

For the X-axis a) move the table by slow feed until the stylus touches the block, note the dial gauge readings and position of the handle. Feed the handle a little more (2 mm for example) and feed back to the first handle position.

Take the dial gauge readings and note the difference of these.

Repeat the check five times at the same handle position, and take the mean value of the differences of the readings as backlash at that position.

Check backlash at three positions of both ends and the mid-position of the axis, and take the maximum value as the axis backlash.

Repeat the check in the same way for Y-axis b) and Z-axis c).

6.2 Numerically controlled axes

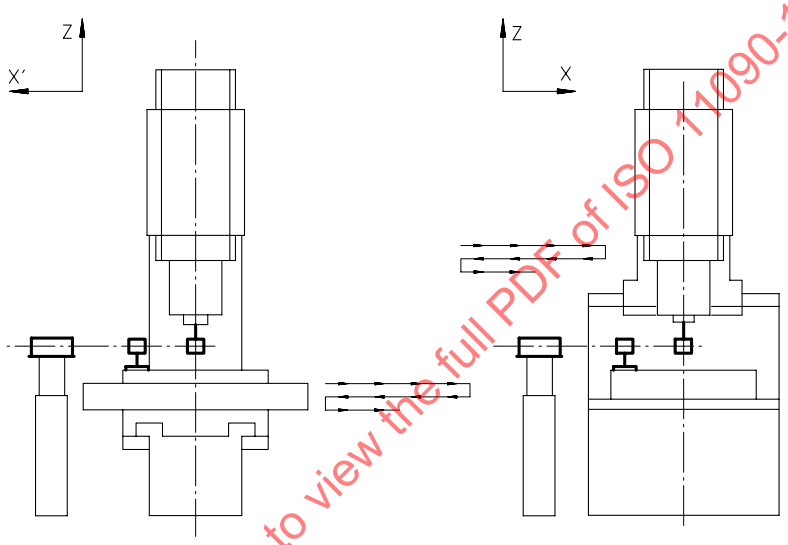
To apply these tests, reference should be made to ISO 230-2, especially for the environmental conditions, warming up the machine, measuring methods, and evaluation and interpretation of the results.

Checking the W-axis is not included because W movement is used for adjusting the head position. When required it shall be done as the same with Z-axis.

Object **P2**

Checking of accuracy, repeatability and reversal value of positioning of the X-axis motion.

Diagram



Tolerance		Measuring length ⩽ 500	⩽ 1 000	⩽ 2 000	**Measured deviation**
Bidirectional accuracy of positioning *)	A	0,011	0,015	0,019	
Unidirectional repeatability of positioning *)	R↑ and R↓	0,005	0,007	0,009	
Bidirectional repeatability	R	0,009	0,012	0,015	
Reversal value of axis *)	B	0,008	0,010	0,013	
Mean reversal value	$\bar{B}$	0,004	0,005	0,006	
Bidirectional systematic deviation of positioning	E	0,006	0,007	0,008	
Range of the mean bidirectional positional deviation of the axis	M	0,002	0,003	0,004	
*) May provide a basis for machine acceptance.					

Measuring instruments

Standard scale of length and microscope or laser measurement equipment

Observations and reference to ISO 230-1 2.322.1

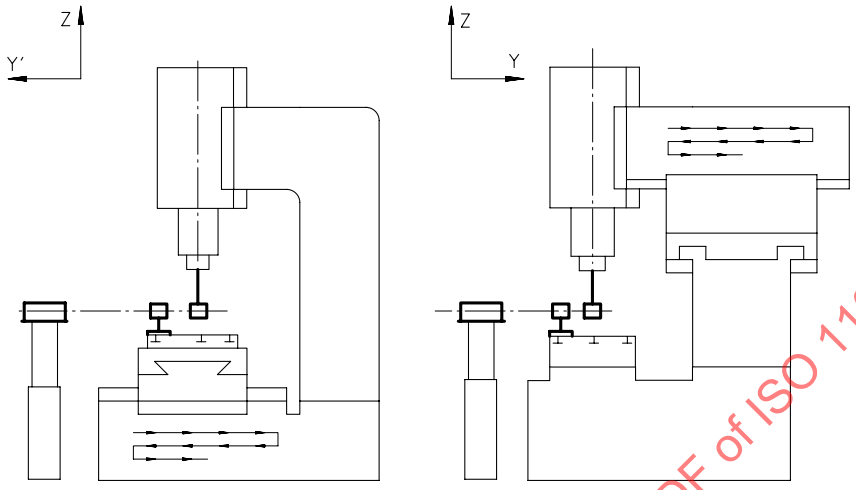
Standard scale of length, or beam axis of laser measurement equipment, shall be set parallel to the axis under test.

Rapid feed is used for positioning in principle, but arbitrary feed rate can be used by agreement between user and supplier/manufacturer.

Object **P3**

Checking of accuracy, repeatability and reversal value of positioning of the Y-axis motion.

Diagram



Tolerance		Measuring length ⩽ 500	⩽ 1 000	⩽ 2 000	**Measured deviation**
Bidirectional accuracy of positioning *)	A	0,011	0,015	0,019	
Unidirectional repeatability of positioning *)	$R^{\uparrow}$ and $R^{\downarrow}$	0,005	0,007	0,009	
Bidirectional repeatability	R	0,009	0,012	0,015	
Reversal value of axis *)	B	0,008	0,010	0,013	
Mean reversal value	$\overline{B}$	0,004	0,005	0,006	
Bidirectional systematic deviation of positioning	E	0,006	0,007	0,008	
Range of the mean bidirectional positional deviation of the axis	M	0,002	0,003	0,004	
*) May provide a basis for machine acceptance.					

Measuring instruments

Standard scale of length and microscope or laser measurement equipment

Observations and reference to ISO 230-1 2.322.1

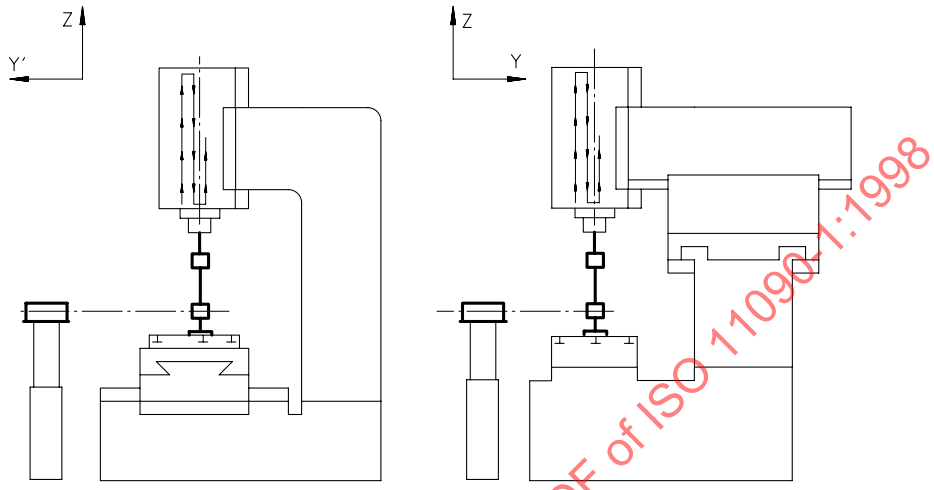
Standard scale of length, or beam axis of laser measurement equipment, shall be set parallel to the axis under test.

Rapid feed is used for positioning in principle, but arbitrary feed rate can be used in agreement between user and supplier/manufacturer.

Object **P4**

Checking of accuracy, repeatability and reversal value of positioning of the Z-axis motion.

Diagram



Tolerance		Measuring length ⩽ 250	⩽ 500	⩽ 1 000	**Measured deviation**
Bidirectional accuracy of positioning *)	A	0,009	0,011	0,015	
Unidirectional repeatability of positioning *)	R↑ and R↓	0,004	0,005	0,007	
Bidirectional repeatability	R	0,007	0,009	0,012	
Reversal value of axis *)	B	0,006	0,008	0,010	
Mean reversal value	$\overline{B}$	0,003	0,004	0,005	
Bidirectional systematic deviation of positioning	E	0,005	0,006	0,008	
Range of the mean bidirectional positional deviation of the axis	M	0,002	0,002	0,003	
*) May provide a basis for machine acceptance.					

Measuring instruments

Standard scale of length and microscope or laser measurement equipment

Observations and reference to ISO 230-1 2.322.1

Standard scale of length, or beam axis of laser measurement equipment, shall be set parallel to the axis under test.

Rapid feed is used for positioning in principle, but arbitrary feed rate can be used in agreement between user and supplier/manufacturer.