

International Standard



6155/2

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Acceptance conditions for horizontal spindle capstan, turret and single spindle automatic lathes — Testing of the accuracy —

Part 2: Machinable bar diameters 25 mm or less and chuck diameter up to 160 mm

Conditions de réception des tours semi-automatiques à tourelle revolver et à broche horizontale, et des tours automatiques monobroches — Contrôle de la précision — Partie 2: Tours à diamètres de passage en barre inférieurs ou égaux à 25 mm et en mandrins inférieurs ou égaux à 160 mm

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Descriptors: machine tools, lathes, tests, testing conditions, dimensional measurements, accuracy.

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6155/2 was prepared by Technical Committee ISO/TC 39, *Machine tools*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Acceptance conditions for horizontal spindle capstan, turret and single spindle automatic lathes — Testing of the accuracy —

Part 2: Machinable bar diameters 25 mm or less and chuck diameter up to 160 mm

0 Introduction

This part of ISO 6155 applies only to lathes with a multi-tool turret of machinable bar diameter 25 mm or less and chuck diameter up to 160 mm. This turret can be manually indexed, semi-automatically indexed by motion of the turret slide, or automatically indexed by an independent control setting at the end of the operation.

1 Scope and field of application

This part of ISO 6155 describes, with reference to ISO 230/1, both geometrical and practical tests on general purpose and normal accuracy capstan, turret and single spindle automatic lathes. It deals only with the checking of accuracy of the machine. It does not apply to the testing of the running of the machine (vibrations, abnormal noises, stick-slip motion of components, etc.) or to machine characteristics (such as speeds, feeds, etc.) which should generally be checked before the accuracy is tested.

This part of ISO 6155 does not cover machines with contouring numerical control, machines with sliding headstocks, machines

with rotating tools, nor single spindle automatic lathes with fixed combined system headstock.

2 References

ISO 68, *ISO general purpose screw threads — Basic profile.*

ISO 230/1, *Machine tools — Acceptance code for machine tools — Part 1: Geometric accuracy of the machine operating under no load or finishing conditions.*

ISO 1101, *Technical drawings — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings.*

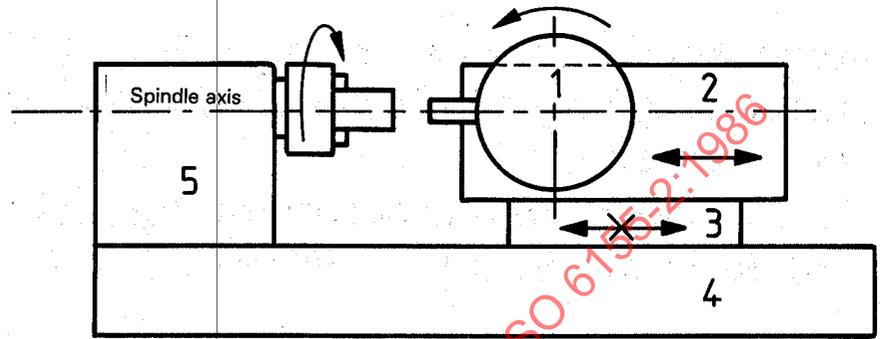
ISO 3442, *Self-centring chucks for machine tools with two-piece jaws (tongue and groove type) — Sizes for interchangeability and acceptance test specifications.*

ISO 6155/1, *Acceptance conditions for horizontal spindle capstan, turret and single spindle automatic lathes — Testing of the accuracy — Part 1: Machinable bar diameters greater than 25 mm.*

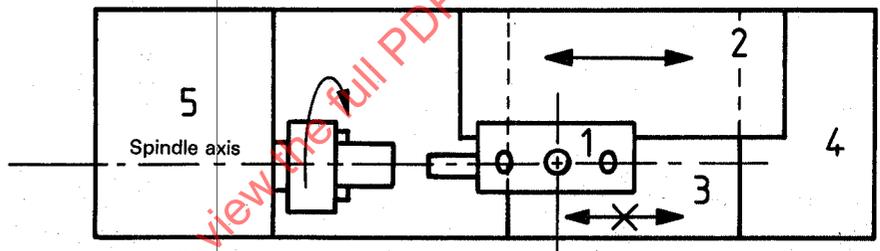
3 Definitions

The machines referred to in this part of ISO 6155 are defined as follows:

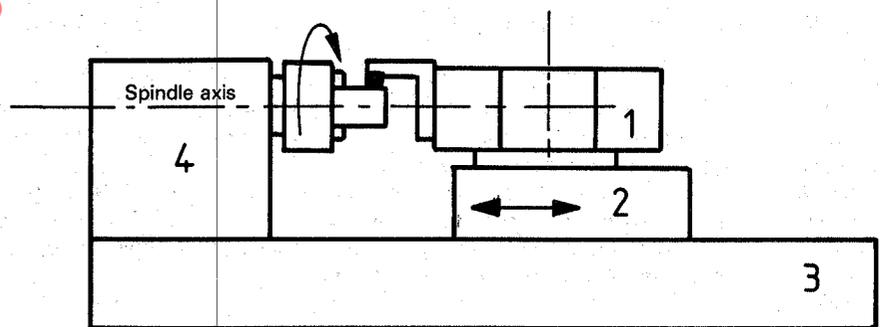
3.1 capstan lathe: A lathe on the bed of which is fitted a slide base that may be manually moved longitudinally along the bed and clamped in the desired position. On this slide base is mounted a short stroke slide which in turn carries an indexing turret which may be automatically operated by the return motion of the slide or manually indexed.



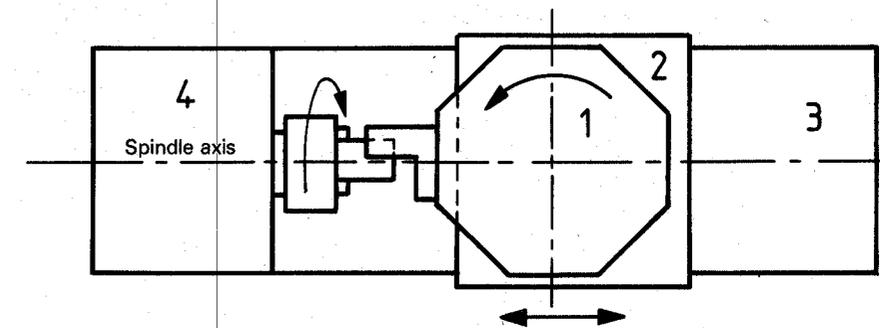
- 1 — Indexable capstan turret
- 2 — Small slide
- 3 — Saddle with manual operation
- 4 — Bed
- 5 — Fixed headstock



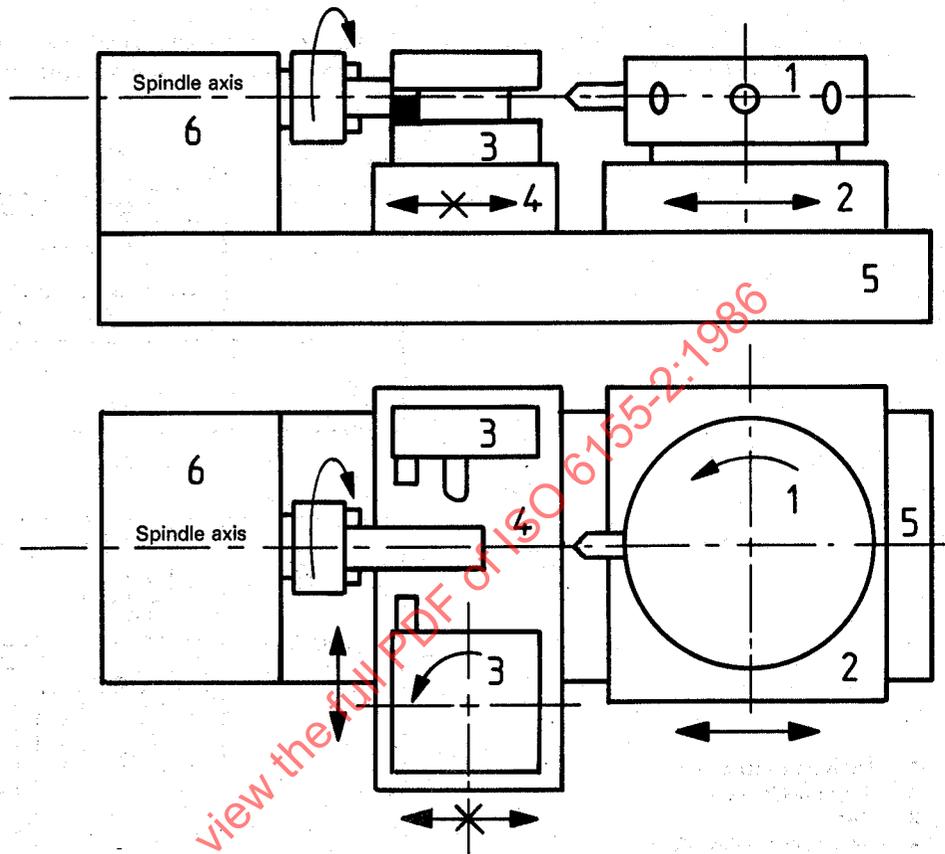
3.2 turret lathe: A lathe on the bed of which is fitted a saddle capable of longitudinal motion, which in turn carries an indexing turret.



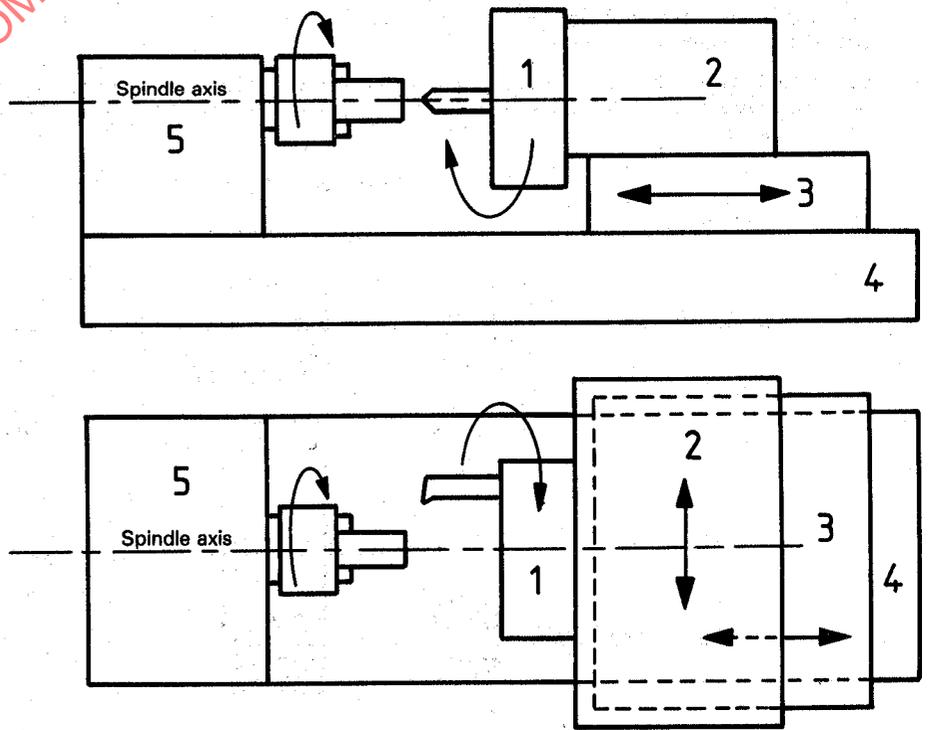
- 1 — Capstan turret
- 2 — Saddle
- 3 — Bed
- 4 — Fixed headstock



3.3 combination turret lathe: A turret lathe with the addition of a second saddle which carries a cross-slide.

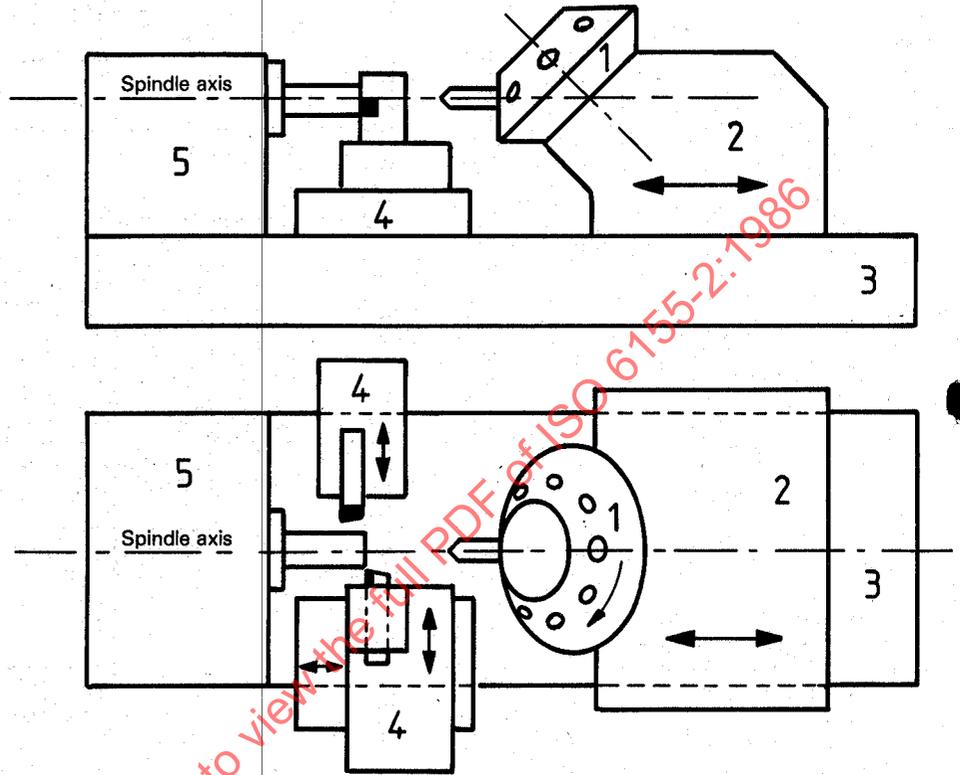


3.4 cross-feeding turret lathe: A lathe on the bed of which is fitted a saddle capable of longitudinal motion, which carries an indexing turret capable of transverse motion.



3.5 single spindle automatic lathe: A lathe having a frame supporting both the spindle headstock and the turret, and in some cases several independent slides.

The axes of the turret bores in the cutting position are always parallel to the spindle axis. The machine shall be capable of functioning under fully automatic cycling control. The method of control should be of any sequential type.

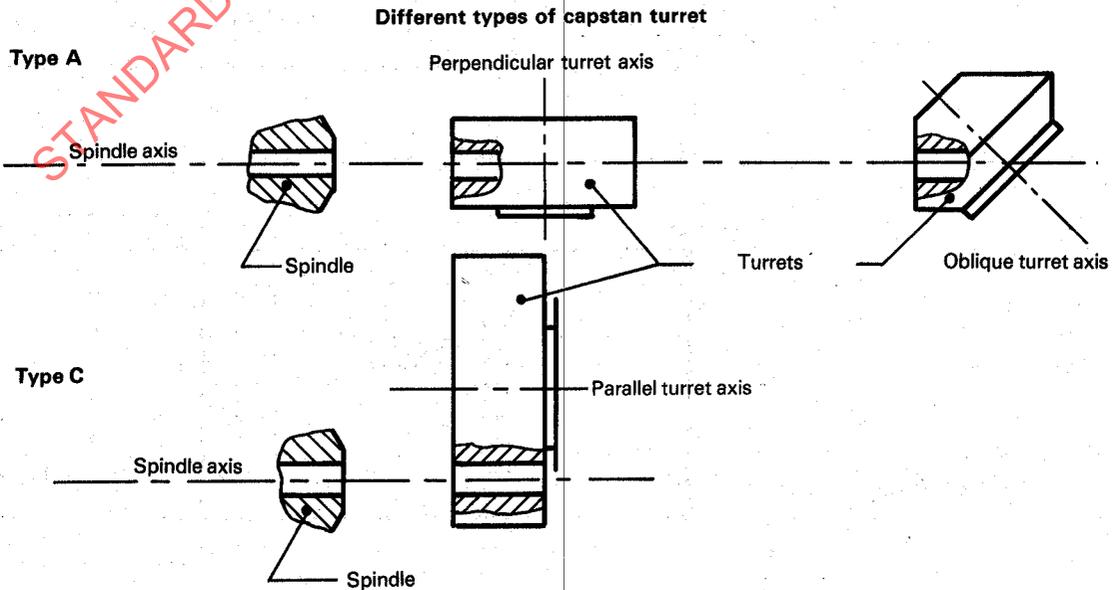


- 1 — Indexing capstan turret
- 2 — Turret holder saddle
- 3 — Bed
- 4 — Independent cross-slides
- 5 — Fixed headstock

NOTE — All these types of lathes are manufactured with a variety of turret configurations. The most common configurations are designated types A and C, and are described below:

turret type A: Circular or multi-sided turrets whose axis of rotation cuts the work spindle axis. Whether or not the turret axis is perpendicular to the work spindle axis, the axis of each turret bore shall align with the work spindle axis in its working position. Tools may be located in the bore, or located and clamped in the bore alone.

turret type C: Circular (drum or disc type) turrets whose axis of rotation is parallel to the work spindle axis. Tools are located in the turret bores, which are parallel to the turret axis, and the turret axis is arranged so that the work spindle axis aligns with the axes of the turret bores in their working positions.



4 Machine sizes

The machines concerned shall correspond to the following criteria, partially or totally:

— swing diameter over the bed	< 250 mm (10 in)
— nominal bar diameter	< 25 mm (1 in)
— nominal chuck diameter, as defined in ISO 3442	< 160 mm (6 in)

NOTE — The choice of the criteria is at the manufacturer's discretion.

5 Preliminary remarks

5.1 In this part of ISO 6155, all dimensions and permissible deviations are expressed in millimetres and in inches.

5.2 To apply this part of ISO 6155, reference should be made to ISO 230/1, especially for the installation of the machine before testing, warming up of spindles and other moving parts, description of measuring methods and recommended accuracy of testing equipment.

5.3 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and this in no way defines the practical order of testing. In order to make the mounting of instruments or gauging easier, tests may be applied in any order.

5.4 When inspecting a machine, it is not always necessary or possible to carry out all the tests described in this part of ISO 6155. It is up to the user to choose, in agreement with the manufacturer, those relating to the properties which are of interest to him, but these tests are to be clearly stated when ordering a machine.

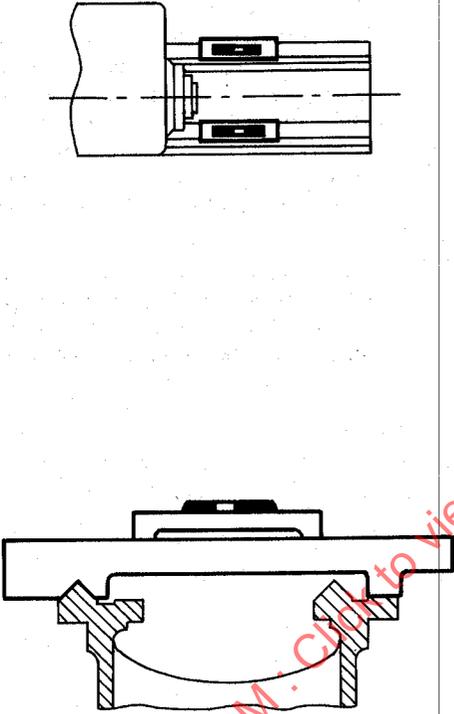
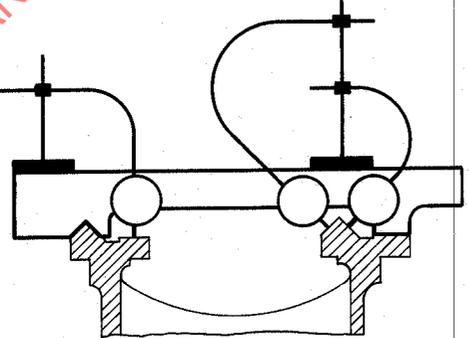
5.5 Practical tests shall be made with finishing cuts and not with roughing cuts which are liable to generate appreciable cutting forces. The actual feeds and speeds will be selected by the manufacturer to suit the particular machine; they may be of the order of 0,1 mm (0.004 in) for depth of cut and 0,1 mm (0.004 in) per revolution for the feed. Test pieces made of a free-cutting metal should be used for the practical tests.

5.6 When establishing the tolerance for a measuring range different from that given in this part of ISO 6155 (see sub-clause 2.311 in ISO 230/1), it should be taken into consideration that the minimum value of tolerance is 0,005 mm (0.000 2 in).

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6 Acceptance conditions and permissible deviations

6.1 Preliminary operations

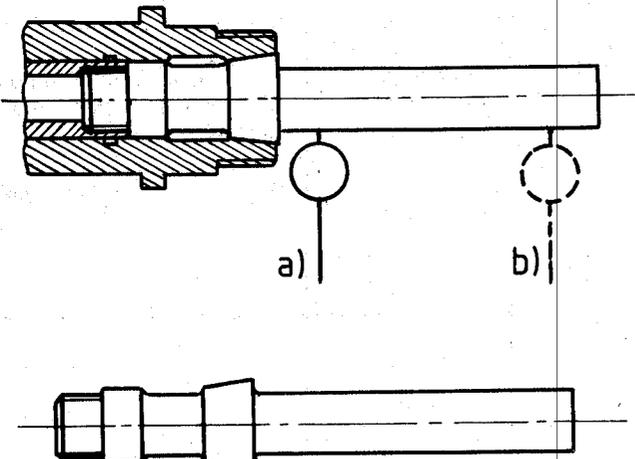
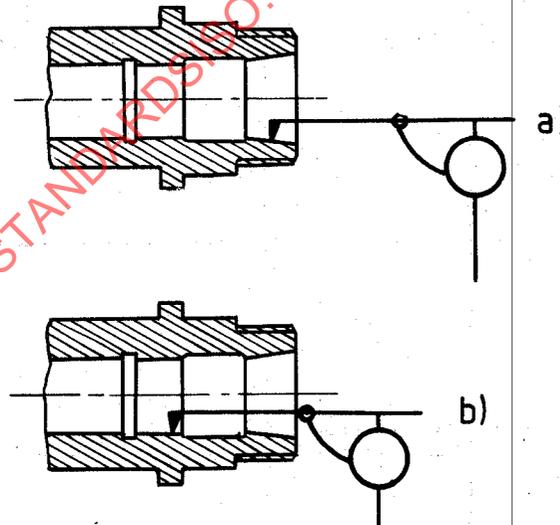
No.	Diagram	Object
G01		<p style="text-align: center;">A — Bed</p> <p>Verification of levelling of slideways:</p> <p>a) Longitudinal verification: straightness of slideways in the vertical plane.</p> <p>b) Transverse verification: slideways should be in the same plane.</p>
G02		<p>Checking of parallelism of the turret slide slideways to the slide base slideways.</p>

Permissible deviation		Measuring instruments	Observations and references to the ISO 230/1 acceptance code
mm	in		
0,015 for any measuring length	0.000 6	Precision levels, optical or other methods	a) Sub-clauses 3.11, 3.21, 5.212.21 and 5.212.22 The measurements shall be carried out at a number of positions equally spaced along the length of the bed.
b) Variation of level: 0,03/1000	0.001 2/40	Precision levels and support	b) Sub-clause 5.412.7 Place a level transversely on the slideways and take measurements at a number of positions equally spaced along the length of the slideways. The variation of level measured at any position shall not exceed the permissible deviation.
0,01 for any measuring length of: 1000 0,01 mm (0.004 in) over the whole bed length, if this is shorter than 1000 mm (40 in).	0.000 4 40	Dial gauge and support	Sub-clause 5.422.5 The test applies only to machines having two sets of slideways integral with the bed. This test is made by means of a special support guided on the outside slideways, and supporting a dial gauge checking the parallelism of the inner slideways.

6.2 Geometrical tests

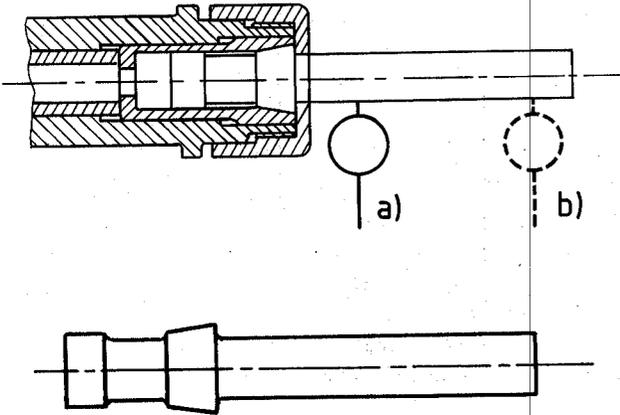
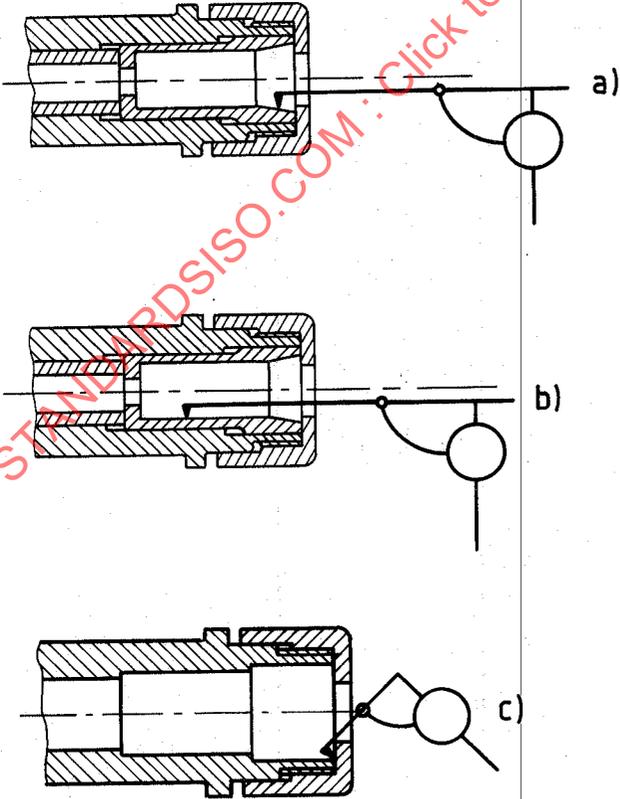
No.	Diagram	Object
G1		<p>B – Headstock spindle</p> <p>a) Measurement of periodic axial slip.</p> <p>b) Measurement of camming of the spindle face.</p>
G2		<p>Measurement of run-out of the centring diameter on the spindle nose.</p>
G3		<p>This test only applies to machines with a locating bore for mounting work holding fixtures.</p> <p>Measurement of run-out of the spindle locating bore.</p>
G4		<p>This test only applies to machines with internal taper spindle bore.</p> <p>Measurement of run-out of the work spindle internal taper</p> <p>a) at the spindle nose;</p> <p>b) at a distance of 100 mm (4 in) from the spindle nose.</p>

Permissible deviation		Measuring instruments	Observations and references to the ISO 230/1 acceptance code
mm	in		
a) 0,008 b) 0,012 including periodic axial slip	a) 0.000 3 b) 0.000 5	Dial gauge and possible special device	a) Sub-clauses 5.622.1 and 5.622.2 The value of force F to be applied for the tests a) and b) shall be specified by the manufacturer. b) Sub-clause 5.632
0,01	0.000 4	Dial gauge	Sub-clause 5.612.2 The value of force F to be applied shall be specified by the manufacturer.
0,008	0.000 3	Dial gauge	Sub-clause 5.612.3
a) 0,008 b) 0,012	a) 0.000 3 b) 0.000 5	Dial gauge and test mandrel	Sub-clause 5.612.3

No.	Diagram	Object
G5	 <p style="text-align: center;">Special test mandrel</p>	<p>This test only applies to bar machines with work spindles for draw back collets.</p> <p>Measurement of run-out of the collet housing in the spindle nose</p> <p>a) at the spindle nose;</p> <p>b) at a distance of 50 mm (2 in).</p>
G5	<p style="text-align: center;">Alternative</p> 	<p style="text-align: center;">Alternative</p> <p>Measurement by touching directly the front seating cone a) and the back register b).</p>

Permissible deviation		Measuring instruments	Observations and references to the ISO 230/1 acceptance code
mm	in		
a) 0,01 b) 0,015	a) 0.000 4 b) 0.000 6	a) and b) Test mandrel and dial gauge	Sub-clause 5.612.3
0,008	a) and b) 0.000 3	Dial gauge	

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No.	Diagram	Object
	 <p style="text-align: center;">Special test mandrel</p>	<p>This test only applies to bar machines with work spindles for closing sleeve-type (dead-length) collets.</p> <p>Measurement of run-out of the collet internal seating in the spindle</p> <p>a) at the spindle nose;</p> <p>b) at a distance of 50 mm (2 in).</p>
G6	<p style="text-align: center;">Alternative</p> 	<p style="text-align: center;">Alternative</p> <p>Measurement of run-out of the collet internal seating in the closing sleeve at a) and b).</p> <p>Measurement of camming of the internal surface of the nut on the spindle nose.</p>

Permissible deviation		Measuring instrument	Observations and references to the ISO 230/1 acceptance code
mm	in		
a) 0,015 b) 0,02	a) 0.000 6 b) 0.000 8	Test mandrel and dial gauge	
0,008	a) and b) 0.000 3	Dial gauge	Sub-clause 5.612.3
0,012	c) 0.000 5		

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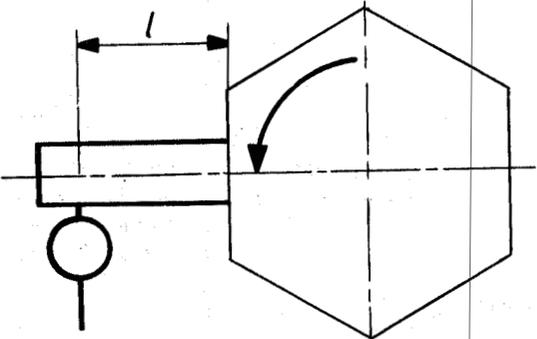
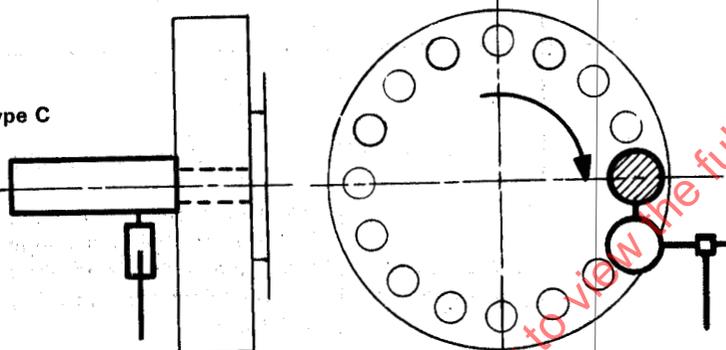
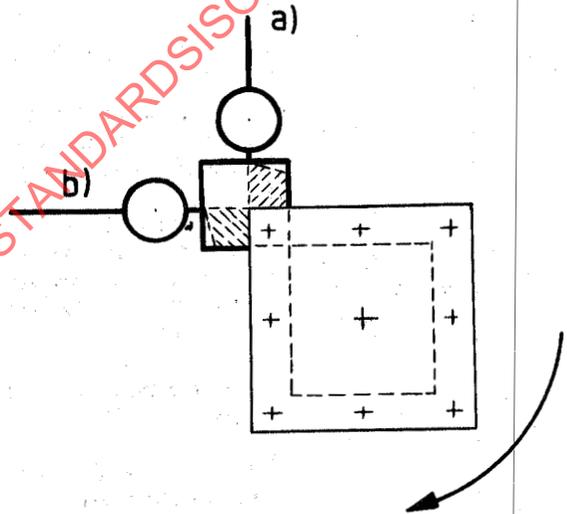
No.	Diagram	Object
G7		<p style="text-align: center;">C – Slide bases</p> <p>Checking of squareness of the transverse movement of the cross-slide to the axis of rotation of the spindle.</p> <p>NOTE – This test applies to chucking machines only. Practical test P2 may be used as an alternative.</p>
G8		<p>Checking of parallelism of the longitudinal movement of the intermediate carriage to the axis of rotation of the spindle</p> <p>a) in a horizontal plane; b) in a vertical plane.</p>
G9		<p style="text-align: center;">D – Turret</p> <p>This test only applies to turret lathes.</p> <p>Checking of parallelism of the turret movement on the bed to the axis of rotation of the spindle</p> <p>a) in a horizontal plane; b) in a vertical plane.</p>

Permissible deviation		Measuring instruments	Observations and references to the ISO 230/1 acceptance code
mm	in		
<p>0,01/100</p> <p>For slide with one tool holder only</p> <p>$\alpha > 90^\circ$</p>	<p>0.000 4/4</p>	<p>Dial gauge and flat disc or straightedge</p>	<p>Sub-clauses 5.522.3 and 5.22</p> <p>The dial gauge is mounted on the cross-slide.</p>
<p>a) 0,005</p> <p>for a measuring length of:</p> <p>100</p> <p>(free end of mandrel forwards only)</p> <p>b) 0,007</p> <p>for a measuring length of:</p> <p>100</p> <p>(free end of mandrel upwards only)</p> <p>NOTE — For machines with a stroke of less than 100 mm (4 in), the tolerances remain the same.</p>	<p>a) 0.000 2</p> <p>4</p> <p>b) 0.000 3</p> <p>4</p>	<p>Dial gauge and test mandrel</p>	<p>Sub-clause 5.422.3</p> <p>The dial gauge is mounted on the cross-slide.</p>
<p>0,01</p> <p>for a measuring length of:</p> <p>150</p> <p>(upwards only)</p> <p>NOTE — For machines with a stroke of less than 150 mm (6 in), the tolerances remain the same.</p>	<p>a) and b)</p> <p>0.000 4</p> <p>6</p>	<p>Dial gauge and test mandrel</p>	<p>Sub-clause 5.422.3</p> <p>The dial gauge is mounted on the turret.</p>

No.	Diagram	Object
G10		<p>This test only applies to capstan lathes.</p> <p>Checking of parallelism of the work spindle axis to the turret top slide movement on the capstan slide</p> <p>a) in a horizontal plane ; b) in a vertical plane.</p>
G11		<p>This test does not apply to machines without tool shank clamping facilities.</p> <p>Checking of parallelism of the turret bores with the turret movement</p> <p>a) in a horizontal plane ; b) in a vertical plane.</p>
G12		<p>Checking of alignment of the work spindle axis with the turret bore axes.</p> <p>Alternative</p> <p>Checking by direct measurement of the turret bores.</p>

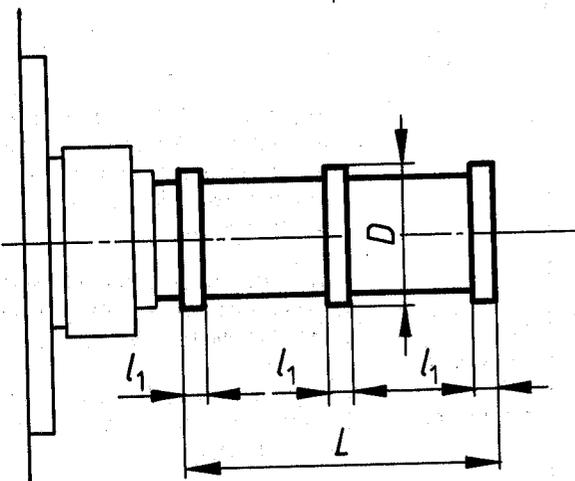
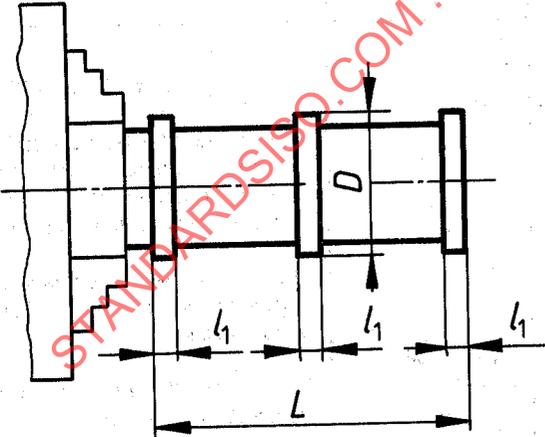
Permissible deviation		Measuring instruments	Observations and references to the ISO 230/1 acceptance code
mm	in		
<p>a) and b)</p> <p>0,010</p> <p>for a measuring length of:</p> <p>100</p> <p>(upwards only)</p> <p>NOTE — For machines with a stroke of less than 100 mm (4 in), the tolerances remain the same.</p>	<p>0.000 4</p> <p>4</p>	<p>Dial gauge and test mandrel</p>	<p>Sub-clause 5.422.3</p> <p>The dial gauge is mounted on the turret. The relative positions of the turret top slide and the capstan slide shall be specified by the manufacturer.</p>
<p>a) and b)</p> <p>0,01</p> <p>for a measuring length of:</p> <p>50</p>	<p>0.000 4</p> <p>2</p>	<p>Dial gauge and test mandrel</p>	<p>Sub-clause 5.422.3</p> <p>The test mandrel should not be clamped in the turret but shall be a tight fit. Where the turret bores are relieved, the test mandrel shall be lightly clamped using the locking mechanism.</p> <p>The test shall be repeated for each turret bore.</p>
<p>0,015</p>	<p>0.000 6</p>	<p>Dial gauge with or without test mandrel</p>	<p>Sub-clause 5.442</p> <p>The dial gauge shall be placed as close as possible to the turret face, and the spindle shall be rotated through 360°.</p> <p>The test mandrel should not be clamped in the turret but shall be a tight fit. Where turret bores are relieved, the test mandrel shall be lightly clamped using the locking mechanism.</p> <p>The test shall be repeated for each turret bore.</p> <p>NOTE — The reading on dial gauge to be divided by two before comparison to permissible deviation.</p>

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No.	Diagram	Object
G13	<p>Type A</p>  <p>Type C</p> 	<p>Checking of the repeatability of the turret indexing.</p> <p>NOTE — Practical test P1c) may be used as an alternative to this test.</p>
G14		<p>Checking of repeatability of indexing of square turret on cross-slide</p> <p>a) in a radial plane;</p> <p>b) Alternative: in an axial plane.</p>

Permissible deviation		Measuring instruments	Observations and references to the ISO 230/1 acceptance code
mm	in		
0,01	0.000 4	Dial gauge and test mandrel	<p>The test mandrel shall be held in the bore of a tool holder which is mounted on to the turret and set on the spindle centre line. The dial gauge is mounted on a fixed part of the machine.</p> <p>With the turret at the mid-position of the stroke, position the dial gauge against the mandrel. Make a first reading.</p> <p>Then withdraw the turret, index through 360° and reposition (under automatic cycle, if any).</p> <p>Note the new reading.</p> <p>Repeat the procedure at least three times on each turret face.</p> <p>The error is represented by the difference between maximum and minimum readings.</p>
<p>Type A</p> <p>Measurement made at a distance <i>l</i> of:</p> <p>50 from the turret face</p>			
0,01	0.000 4	Dial gauge and test bar	<p>Sub-clause 6.42</p> <p>The test bar shall be mounted in the square turret to simulate a tool. The dial gauge shall be mounted on a fixed part of the machine. Make a first reading.</p> <p>The turret to be pushed back along the axis perpendicular to the direction of the dial gauge stylus.</p> <p>Then index the turret through 360° and reposition at the measuring position. Note the new reading.</p> <p>Repeat the procedure at least three times for each turret face.</p> <p>The error is represented by the difference between maximum and minimum readings.</p> <p>NOTE — For a) and b), the dial gauge shall be set in the plane of the face of the turret.</p>
<p>Type C</p> <p>Measurement made as close as possible to the tool holder face.</p>			
0,02	0.000 8		
a) and b)			

6.3 Practical tests

No.	Diagram	Nature of test and cutting conditions	Checks to be applied
<p>P1</p>	<p style="text-align: center;">$l_1 = 5 \text{ mm (0.2 in.) min.}$</p>  <p>For bar machines: $D = 0,8 \times$ nominal bar diameter capacity of lathe $L = 0,8 \times$ maximum cutting stroke or $= 2,5 \times$ nominal bar diameter capacity of lathe Adopt the smaller of these values for L, up to a maximum value of 50 mm (2 in).</p>	<p>This test applies to both bar and chucking machines.</p> <p>Turning of a cylindrical test piece held in or on the spindle nose from the turret with a single point tool mounted on one face of the turret and on the cross-slide.</p> <p>For test c), repeatability, at least three test pieces shall be machined. Turret shall be indexed through 360° before machining a new test piece.</p> <p>As an alternative, test P1c) may be carried out on stub test pieces with a minimum length of cut of 10 mm (0.4 in).</p> <p>Test piece material, together with type and form of tool, feed, depth of cut and cutting speed, to be specified by the manufacturer.</p>	<p>a) Circularity</p> <p>Variation in radius at the location end of the test piece for at least four readings (sub-clause 14.3 of ISO 1101).</p> <p>b) Consistency of the machined diameters</p> <p>This test applies to turrets with an axis parallel or perpendicular to the spindle axis.</p> <p>The consistency of the machined diameters is the variation between the diameters of each machining bearing measured in a single axial plane.</p> <p>Make three or four measurements, depending on the length of the test piece.</p> <p>c) Repeatability</p> <p>Variation between diameters of the location end of the test pieces, measured in a single plane marked on the spindle nose.</p>
	<p style="text-align: center;">$l_1 = 5 \text{ mm (0.2 in.) min.}$</p>  <p>For chucking machines: $D = 0,3 \times$ nominal chuck diameter [up to a maximum value of 50 mm (2 in)] $L = 0,8 \times$ maximum cutting stroke or $= 0,8 \times$ nominal chuck diameter Adopt the smaller of these values for L, up to a maximum value of 100 mm (4 in).</p>		