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## Dentistry — Test methods for rotary instruments

*Médecine bucco-dentaire — Méthodes d'essai pour instruments rotatifs*

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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.

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 106, *Dentistry*, Subcommittee SC 4, *Dental instruments*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 55, *Dentistry*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 8325:2004), which has been technically revised.

The main changes compared to the previous edition are as follows:

- a) some definitions have been added such as for rotary instruments;
- b) list of suitable measuring instruments have been deleted from [4.3](#);
- c) tolerances for the measuring instruments have been clarified in [5.1](#);
- d) the formula for neck strength test has been replaced in [5.11](#) by a technically based Formula in [5.11.4](#);
- e) [Annex A](#) has been added for the deduction of [Formula \(3\)](#).

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

To check the conformity of dental rotary instruments against relevant instrument standards, it is indispensable to conduct tests on the basis of harmonized test methods in order to achieve comparable test results. In the respective instrument standards for dental rotary instruments, reference is made to the test methods specified in this document.

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# Dentistry — Test methods for rotary instruments

## 1 Scope

This document specifies general test methods for rotary instruments used in dentistry. These test methods are used for measuring the dimensional characteristics, neck strength and surface roughness of rotary instruments, such as burs, cutters, polishers, grinding instruments and rotary instruments used for oral surgery such as drills and countersinks.

Specific tests are specified in the respective instrument standards, if available.

This document does not specify test methods for materials used for rotary instruments.

NOTE For materials used for rotary instruments, see ISO 21850-1 and respective instrument standards.

This document is not applicable to endodontic instruments. For endodontic instruments, see ISO 3630-1.

## 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 1797, *Dentistry — Shanks for rotary and oscillating instruments*

ISO 1942, *Dentistry — Vocabulary*

ISO 3274, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*

ISO 13295, *Dentistry — Mandrels for rotary instruments*

ISO 21850-1, *Dentistry — Materials for dental instruments — Part 1: Stainless steel*

ISO 21920-3, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 3: Specification operators*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1942, ISO 21850-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **rotary instrument**

instrument used with a continuous rotation in a handpiece used for dental procedures

[SOURCE: ISO 1942:2020, 3.4.1.3, modified — “consisting of a shank and a working part,” has been deleted from the definition.]

### 3.2

#### **run-out**

inaccuracy of *rotary instrument* (3.1), specifically that the working end or shank does not rotate exactly in line with the main axis

### 3.3

#### **bending moment**

reaction induced in a *rotary instrument* (3.1) when an external force (e.g. by the hand of the dentist) is applied to the rotary instrument, causing the instrument to bend

## 4 Measurement and test methods

### 4.1 General

The measurement and test methods specified in this document refer to the main characteristics of rotary instruments used in dentistry. They are demonstrated by describing the test procedures for the single characteristics of rotary instruments.

In addition to the measurement and test methods specified, other equivalent measurement and test methods and test devices exist and can be used; they can render similar test results.

In case of dispute, however, the measurement and test methods specified in this document become the reference methods.

For the evaluation of the test results, see the relevant instrument standards.

### 4.2 Ambient conditions

Tests shall be conducted at ambient temperature of 18 °C to 28 °C.

### 4.3 Measurements

Lengths and diameters shall be measured and calculated in millimetres, angles in degrees, forces in Newton or milliNewton and torques in milliNewtonmetres.

## 5 Measurement of single characteristics

### 5.1 Measuring instrument

A measuring instrument with a measuring resolution of  $\leq 10\%$  of the tolerance range of the intended dimensions shall be used.

The manufacturer shall determine and provide the measuring devices needed to ensure valid and reliable results when measuring is used to verify the conformity of products to requirements.

### 5.2 Shape of the working part

Determine the shape of the working part of the rotary instrument visually or by using a measuring instrument specified in 5.1.

Conduct one set of measurements.

### 5.3 Diameter of the working part

#### 5.3.1 Location of measurement points

Determine the shape of the working part of the rotary instrument visually.

The location of measurement points shall be as follows, unless specified differently in the respective instrument standard:

- a) for cylindrical rotary instruments: the middle of the working part;
- b) for non-cylindrical rotary instruments: the largest diameter of the working part.

Use an instrument as specified in [5.1](#).

Conduct one set of measurement.

### 5.3.2 Procedure

Measure the diameter of the working part of the rotary instrument using an instrument as specified in [5.1](#).

Conduct measurements on the peripheral surface, for example, on the diameter of the largest cutting blade.

Conduct three or four measurements, as appropriate, at angles of approximately 120° or 90° as appropriate, apart on the circumference of the test piece. Lift the blade before rotating the test piece to the next measurement point. Record the three measuring results as  $d_1$ ,  $d_2$  and  $d_3$ .

### 5.3.3 Evaluation of test results

Calculate the average diameter of the rotary instrument by using [Formula \(1\)](#):

$$d = \frac{d_1 + d_2 + d_3}{3} \quad (1)$$

where

$d_1$  is the diameter of measurement 1;

$d_2$  is the diameter of measurement 2;

$d_3$  is the diameter of measurement 3.

## 5.4 Neck diameter

### 5.4.1 Location of measurement points

The location of measurement points shall be the smallest diameter just behind the working part or just behind the collar, where applicable.

### 5.4.2 Procedure

Measure the neck diameter of the rotary instrument by using an instrument as specified in [5.1](#).

Conduct one measurement.

## 5.5 Dimensions of shanks

The dimensions of the shank shall be determined in accordance with ISO 1797.

### 5.5.1 Shank diameter

The measurement locations shall be determined in accordance with ISO 1797.

### 5.5.2 Shank length

The locations of measurements shall be the points from the end of the shank to the shortest length where shank diameter enlargement or reduction occurs.

### 5.6 Dimensions of mandrels

The dimensions of the mandrel shall be determined in accordance with ISO 13295.

### 5.7 Length of working part

#### 5.7.1 Location of measurement points

The location of measurement points shall be the points at the ends of the shortest length of the working part, including, where applicable, the coated neck.

#### 5.7.2 Procedure

Measure the length of the working part using an instrument as specified in [5.1](#).

Conduct one measurement.

### 5.8 Overall length

#### 5.8.1 Location of measurement points

The location of measurement points shall be the two ends of the rotary instrument, including tip and shank end.

#### 5.8.2 Procedure

Measure the overall length of the rotary instrument using an instrument as specified in [5.1](#).

Conduct one measurement.

### 5.9 Angle of taper of working part

#### 5.9.1 Location of measurement points

The location of measurement points shall be on the taper surface of the working part of the test piece. Use at least two measurement points, which are apart from each other as far as possible.

#### 5.9.2 Procedure

Determine the included angle with an instrument as specified in [5.1](#).

Measure the relevant diameters and the length of the taper. Then calculate the angle of the taper.

Conduct one measurement.

## 5.10 Run-out of the working part

### 5.10.1 Apparatus

#### 5.10.1.1 Holding device

The following holding device is used for the test:

- split V-block with adjustable distances  $l_1$  and  $l_2$  (see [Figure 1](#)): for rotary instruments with shanks in accordance with ISO 1797;
- equivalent device, for example precision chuck: for instruments with shanks in accordance with ISO 1797;
- equivalent device: for mandrels.

NOTE The measuring device is not exclusively a physical contact device.

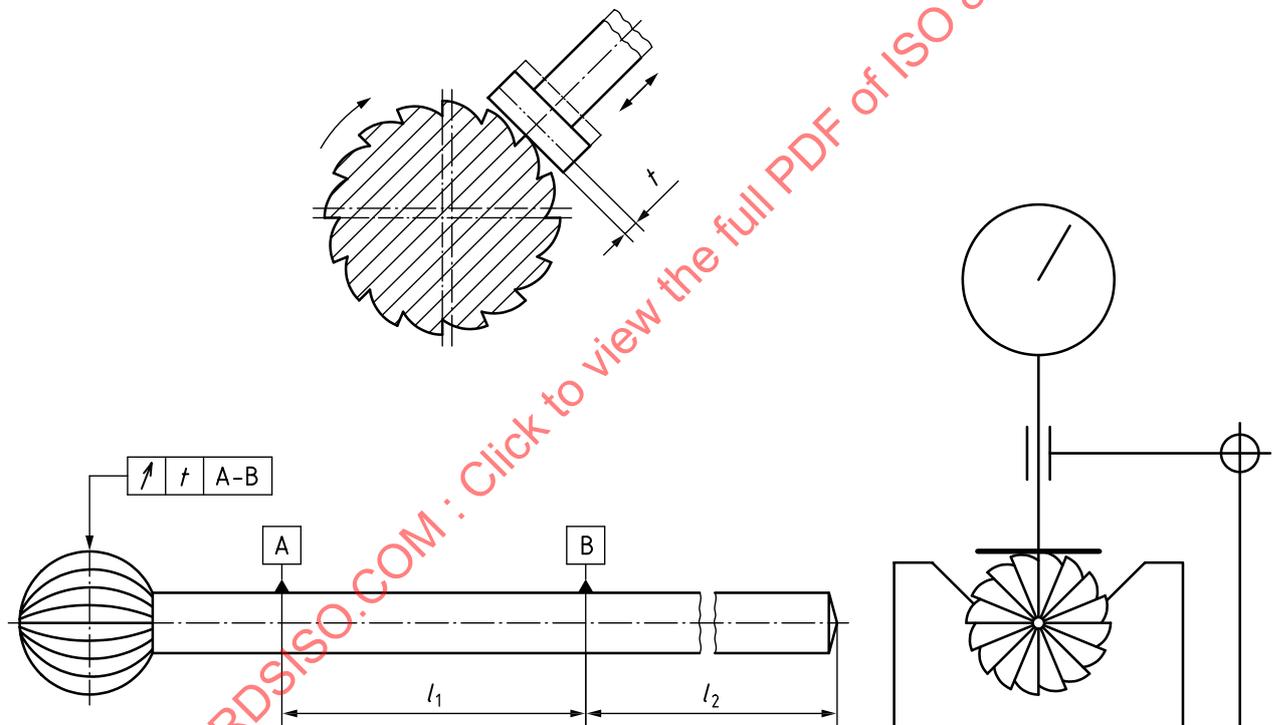


Figure 1 — Example of a V-block measuring device

The length  $l_1$  and  $l_2$  depend on the type of shank and the fitting length of the test piece. They shall be in accordance with [Table 1](#).

Table 1 — Dimensions  $l_1$  and  $l_2$

Shank type ISO 1797	Fitting length ISO 1797 mm	$l_1$ mm	$l_2$ mm
1	9	5	3
1	11 and 12	7	3
2	15	10	3
2	30	9	20
3	9	5	2

**Table 1** (continued)

Shank type ISO 1797	Fitting length ISO 1797 mm	$l_1$	$l_2$
		mm	mm
3	11 and 12	7	2
4	15	10	3
4	30	9	20

### 5.10.1.2 Measuring instrument

The applied measuring force shall not influence the measuring result.

### 5.10.2 Location of measurement points

The location of measurement point is on top of the surface of the test piece, as specified in the relevant instrument standards.

If no specification is given, the location of measurement point is:

- for cylindrical rotary instruments: the middle of the working part;
- for other shapes of rotary instruments: the largest diameter of the working part.

### 5.10.3 Procedure

Set the lengths  $l_1$  and  $l_2$  of the holding device (5.10.1.1) according to the type of shank (see Table 1) to be tested. Place the test piece in the holding device and turn it slowly through 360°. Measure the run-out on top of the surface or blade edges (if present) of the working part using a measuring instrument as specified in 5.10.1.2.

Record the highest ( $t_2$ ) and the lowest ( $t_3$ ) reading. Calculate the difference of both readings as the total indicated run-out ( $t_1$ ), using Formula (2):

$$t_1 = t_2 - t_3 \quad (2)$$

where

- $t_1$  is the total indicated run-out;
- $t_2$  is the highest reading of the run-out;
- $t_3$  is the lowest reading of the run-out.

## 5.11 Neck strength test

### 5.11.1 Apparatus

#### 5.11.1.1 Test load device

A device shall be used which permits a load,  $F$ , to be applied to the free end of the test piece with its long axis held in a chuck at an angle of 22,5° to the horizontal. The chuck should enable test pieces of different lengths to be inserted to a depth as described in 5.10.3.

#### 5.11.1.2 Measuring instrument

The applied measurement force shall not influence the measuring result.

### 5.11.2 Test force

The test force to be applied shall be that given in the relevant instrument standard.

The test force shall be applied under an angle of inclination of 22,5° to horizontal.

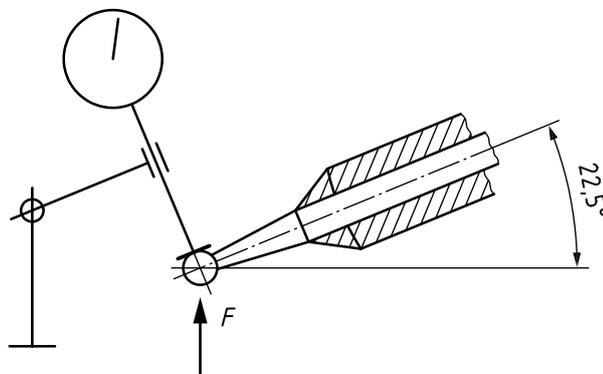


Figure 2 — Test piece at 22,5° to horizontal

### 5.11.3 Procedure

#### 5.11.3.1 Bending effect on run-out

Place the test piece in the chuck so that it is gripped up to the junction of neck and shank. Rotate the test piece and record the maximum run-out ( $t_4$ ). Set the test piece with the maximum run-out vertically upward. Apply the load, vertically upward, as shown in [Figure 2](#), or as specified in the relevant instrument standard.

Apply the load  $F$  for a period of 5 s. If the test piece does not break measure the run-out ( $t_5$ ) again.

Record the run-out induced by the load.

Exclusion: For long and pointed instruments which have an opening angle of the tip of maximum 30°, the resulting run out shall not exceed 0,15 mm.

#### 5.11.3.2 Bending effect on breaking

Place the test piece in the chuck so that it is gripped up to the junction of neck and shank. Position the measuring device at the point where the load is applied. Set the dial at zero called as  $t_0$ . Apply the load vertically upward, as shown in [Figure 2](#), or as specified in the relevant instrument standard.

Apply the load  $F$  for a period of 5 s. If the test piece does not break measure the run-out ( $t_5$ ) again.

Record the deformation induced by the load.

### 5.11.4 Calculation of test force for neck strength

The diameter of the working part shall be greater than the minimum neck diameter.

If  $L \leq 5D$  stop the test.

For rotary instruments, when  $L > 5D$ , calculate the test force with [Formula \(3\)](#) for the neck strength:

$$F = k \frac{D^3}{L} \quad (3)$$

where

- $F$  is the applied test force, expressed in Newton;
- $k$  is a constant (shape and material) value, derived from experience,  $k = 81,8 \text{ N/mm}^2$ ;
- $D$  is the minimum neck diameter behind the end of the working part of the rotary instrument, expressed in millimetres;
- $L$  is the length from the tip of the working part to the minimum neck diameter of the rotary instrument, expressed in millimetres.

NOTE The deduction of [Formula \(3\)](#) is described in [Annex A](#).

The k-factor is specified in the relevant instrument standard.

### 5.11.5 Evaluation

Calculate the permanent set,  $t_6$ , by using [Formula \(4\)](#):

$$t_6 = t_5 - t_4 \quad (4)$$

where

- $t_4$  is the maximum run-out before application of the force;
- $t_5$  is the maximum run-out after application of the force.

### 5.12 Surface roughness

Determine the surface roughness in accordance with ISO 3274 and ISO 21920-3.

## 6 Test report

A test report shall be prepared. It shall include at least the following information:

- a) Identification of rotary instrument (e.g. reference number, lot number);
- b) reference to this document, i.e. ISO 8325:2023;
- c) the test method used;
- d) any deviations from the procedure;
- e) any unusual features observed;
- f) test results;
- g) name of testing organization;
- h) date of test.