भारतीय मानक
Indian Standard

IS 13701 : 2024
ISO 8325: 2023

दंत चिकित्सा — रोटरी उपकरणों के लिए परीक्षण पद्धतियाँ

(दूसरा पुनरीक्षण)

Dentistry — Test Methods for Rotary Instruments

(Second Revision)

ICS 11.060.20

भारतीय मानक ब्यूरो
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Dentistry Sectional Committee, MHD 08

NATIONAL FOREWORD

This Indian Standard (Second Revision) which is identical to ISO 8325 : 2023 'Dentistry — Test methods for rotary instruments' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Dentistry Sectional Committee and approval of the Medical Equipment and Hospital Planning Division Council.

This standard was first published in 1993 and was identical to ISO 8325 : 1985 'Dental rotary instruments test methods'. The standard was revised in 2018 to align it with the latest version of ISO 8325 : 2004. This revision of this standard has been brought out to align it with the latest version of ISO 8325 : 2023. After publication of this standard, IS 13701 : 2018/ISO 8325 : 2004 stands withdrawn.

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are however not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'; and

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 1797 Dentistry — Shanks for rotary and oscillating instruments	IS/ISO 1797 : 2017 Dentistry — Shanks for rotary and oscillating instruments	Identical
ISO 1942 Dentistry — Vocabulary	IS 17895 : 2023/ISO 1942 : 2020 Dentistry — Vocabulary	Identical
ISO 3274 Geometrical product specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments	IS 15261 : 2002/ISO 3274 : 1996 Geometrical product specifications (GPS) — Surface texture : Profile method — Nominal characteristics of contact (stylus) instruments	Identical
ISO 21850-1 Dentistry — Materials for dental instruments — Part 1: Stainless steel	IS 18781 (Part 1) : 2024/ ISO 21850-1 : 2020" Dentistry — Materials for dental instruments: Part 1 Stainless steel	Identical
ISO 21920-3 Geometrical product specifications (GPS) — Surface texture: Profile — Part 3: Specification operators	IS 18432 (Part 3) : 2023/ ISO 21920-3 : 2021 Geometrical product specifications (GPS) — Surface texture — Profile: Part 3 Specification operators	Identical

The Committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard	*Title*
ISO 13295	Dentistry — Mandrels for rotary instruments

In reporting the result of a test or analysis made in accordance with this standard, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'.

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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.

Indian Standard

DENTISTRY — TEST METHODS FOR ROTARY INSTRUMENTS

(Second Revision)

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 ≤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):

$$d = \frac{d_1 + d_2 + d_3}{3} \tag{1}$$

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:

a) split V-block with adjustable distances l_1 and l_2 (see Figure 1): for rotary instruments with shanks in accordance with ISO 1797;

b) equivalent device, for example precision chuck: for instruments with shanks in accordance with ISO 1797;

c) equivalent device: for mandrels.

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

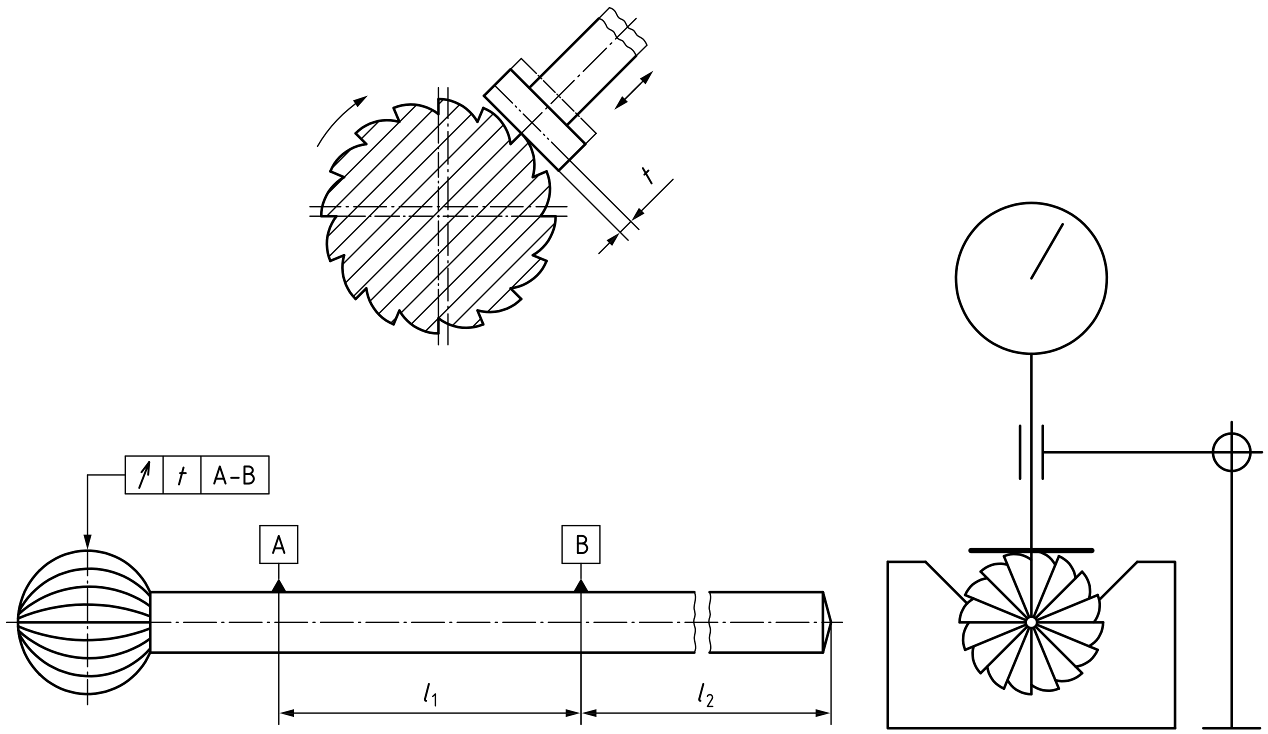


Figure 1 — Example of a V-block measuring device

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 mm	l_2 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:

a) for cylindrical rotary instruments: the middle of the working part;

b) 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):

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

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.

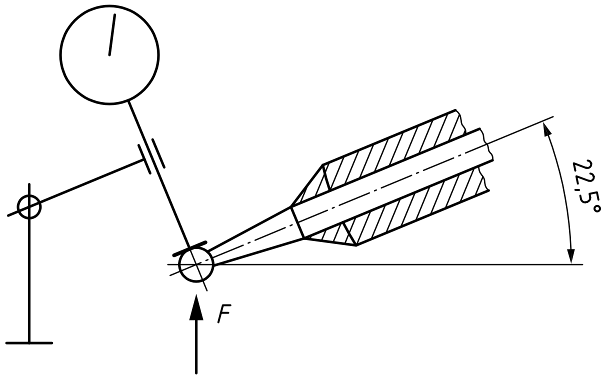


Figure 2 — Test piece at 22,5° to horizontal

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):

$$t_6 = t_5 - t_4 \tag{4}$$

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;

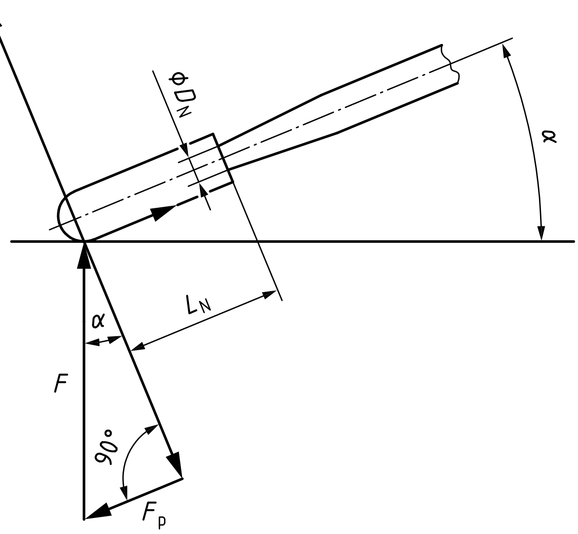
g) name of testing organization;

h) date of test.

Annex A
(informative)

Deduction of the neck strength formula

A.1 Geometry of test arrangement



Key

D_N minimum neck diameter behind the end of the working part

L_N length from contact point to the neck

F test force

$F_\perp$ part of test force normal to the rotary axis of rotary instrument

F_p part of test force parallel to the rotary axis of rotary instrument

α angle of inclination

Figure A.1 — Geometry of arrangement for the bending test

A.2 Static bending moment

The static bending moment resulting from the applied force is calculated using Formula (A.1) (see Figure A.1):

$$M_{bend} = F_\perp \cdot L_N = F \cdot \cos\alpha \cdot L_N \quad \text{(A.1)}$$

where

M_{bend} is the bending moment in Nmm;

$F_\perp$ is the part of test force normal to the axis of rotary instrument;

F is the test force in N;

L_N is the length from the tip to the minimum neck diameter in mm.

A.3 Structure bending moment

The stability of the structure of the shank against bending is described by Formula (A.2):

$$M_{max} = \sigma W \tag{A.2}$$

where

M_{max} is the bending moment in Nmm;

σ is the bending stress in N/mm^2;

W is the section modulus in mm^3.

The section modulus is given by Formula (A.3):

$$W = \frac{2I}{D} \tag{A.3}$$

where

W is the section modulus in mm^3;

I is the second moment of area (second area moment, area moment of inertia, quadratic moment of inertia; geometrical property of an area);

$D/2$ is the distance from neutral axis to outer point (radius is equal to the diameter divided by two).

NOTE 1 The utility of the section modulus is that it characterizes the bending resistance of a cross-section in a single term. The section moduli are available in engineering textbooks tables.

For a circular cross-section, the section modulus W is given by Formula (A.4):

$$W = \frac{\pi D_N^3}{32} \tag{A.4}$$

where

W is the section modulus in mm^3;

D_N is the neck diameter of circular section immediately behind the end of the working part;

π is equal to 3,14.

NOTE 2 This formula for the geometrical form is also used for the calculation of torqueing of orthodontic wires with circular cross-section.

According to Clause A.2, the maximum bending moment for this specific geometrical shape is given by Formula (A.5):

$$M_{max} = \frac{\sigma \pi D_N^3}{32} \tag{A.5}$$

A.4 Calculation of test force

The bending moment reaches the maximum immediately before the instrument breaks. Therefore, the two moments [i.e. Formula (A.6)] are considered as equal:

$$M_{max} = M_{bend} \tag{A.6}$$

$$\frac{\sigma \pi D_N^3}{32} = F \cos\alpha \; L_N \tag{A.7}$$

Solving Formula (A.7) to F results in Formula (A.8):

$$F = \frac{\sigma \pi D_N^3}{32 \cos\alpha \; L_N} \tag{A.8}$$

A.5 Application

For the application at the fixed angle the following values are used: angle α = 22,5°, cos α = 0,923;

For the material (stainless steel) of the shank the following fixed value is used: σ = 769 N/mm^2.

NOTE This value for the bending stress was postulated after examination of existing test forces for rotary instruments.

$$F = \frac{769 \cdot 3{,}14 \cdot D_N^3}{32 \cdot 0{,}923 \cdot L_N} = \frac{81{,}75 \, D_N^3}{L_N} \tag{A.9}$$

The resulting numerical value for diamond rotary instruments is k = 81,8. This is a value, depending on the geometrical form and the material of the shank.

In order to obtain a clear and easy formula, Formula (A.9) is shortened to Formula (A.10):

$$F = k \frac{D^3}{L} \tag{A.10}$$

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Amendments Issued Since Publication

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