TECHNICAL SPECIFICATION

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Dentistry — Bonding test between polymer teeth and denture base materials

Médecine bucco-dentaire — Test d'adhésion entre des dents en polymère et le polymère pour base de prothèse

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Foreword

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This document was prepared by Technical Committee ISO/TC 106, *Dentistry*, Subcommittee SC 2, *Prosthodontic materials*.

Dentistry — Bonding test between polymer teeth and denture base materials

1 Scope

This document specifies a test method for bonding of polymer teeth to denture base materials.

This test method is not designed to prove the properties of polymer teeth and denture base materials.

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 1942, *Dentistry — Vocabulary*

ISO 6873, *Dentistry — Gypsum products*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 20795-1, *Dentistry — Base polymers — Part 1: Denture base polymers*

ISO 22112:2017, *Dentistry — Artificial teeth for dental prostheses*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1942, ISO 20795-1 and the following apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
adhesive fracture
fracture at the interface between the polymer tooth and the denture base materials

3.2
cohesive fracture
fracture in the body of the polymer tooth or the denture base materials

3.3
polymer teeth
artificial teeth made from polymer material

4 Bond between polymer teeth and denture base materials

4.1 General

This test method investigates the bonding of polymer teeth to denture-base materials.

This test method examines the bonding behaviour along the bonding surface. A measurement of the bond strength of polymer teeth to denture base material is only meaningful if the fracture is at least partially adhesive, i.e. progresses along the bonding surface.

This test method is not designed to prove the properties of the polymer teeth and the denture base materials.

4.2 Apparatus and materials

The following apparatus and materials are required for production of the test specimens (see Figure 2):

4.2.1 Addition-cured polyvinyl siloxane, for making a silicone mould (Figure 3) to produce test specimens.

4.2.2 Modelling wax, for production of a cylindrical wax body (see Figure 2).

4.2.3 Dental laboratory processing apparatus/instrument, applicable to the denture base material.

4.2.4 Denture-base material, applicable types in accordance with ISO 20795-1.

4.2.5 Maxillary anterior polymer teeth, with a crown-width of 8-9 mm, a length of 10-11 mm (including the neck) and an adhesion interface about 45 mm^2(see Figure 1), in accordance with ISO 22112.

4.2.6 Dental gypsum, Type 2 or Type 3, in accordance to ISO 6873.

4.2.7 Water bath(s), capable of being maintained at (70 ± 3) °C and at boiling water temperature.

4.2.8 Pressure polymerization vessel.

4.2.9 Timer, accurate to ± 1 s.

4.2.10 Microscope, with 10× magnification.

4.2.11 Mounting device, for mounting cylindrical test specimen as illustrated in Figure 4 to fix test specimens vertical to the shear pin of the testing apparatus. Use a mounting devise with guided shear-pin.

4.2.12 Universal testing machine with built-in load cell, for measuring forces between 10 N and 1000 N. The load cell shall have a measuring inaccuracy of 1 % of the fracture force in accordance with ISO 7500-1, Class 1.

4.2.13 Cylindrical flat shear pin, with a diameter of 4 mm.

Dimensions in millimetres

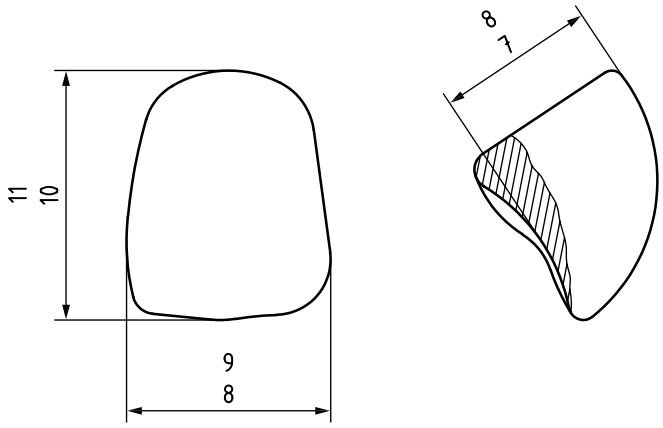


Figure 1 — Tooth size

5 Procedure

5.1 Preparation of test specimen

The preparation of test specimen can be made from prepolymerized materials by other techniques as recommended from the manufacturer, e.g. milling, injection moulding.

All polymer teeth shall be adapted for bonding with applicable types of denture-base polymers in accordance with ISO 20795-1. If there are problems of achieving bonding, the manufacturer's instruction shall contain information about special treatments necessary to achieve bonding and any applicable limitations.

Take six maxillary central incisors (Type 1 in accordance with ISO 22112) with at least two different moulds. Using modelling wax, fasten a central incisor vertically to its axis to a cylinder of wax of dimensions h = 20 mm, diameter = 25 mm, extending the modelling wax to 1 mm above the neck of the tooth (see Figure 2). Prepare a mould of the assembly using addition-cured polyvinyl siloxane ('silicone') impression material (see Figure 3). For other incisors of the same dimension, use the silicone mould prepared as above. Place the incisor in the mould and fill the mould with either wax (for specimen production with denture base polymer Type 1) or autopolymerising acrylic resin (for specimen production with denture base polymer Type 2).

Figure 2 — Test specimen made from modelling wax and polymer tooth

Figure 3 — Silicone mould for production of the test specimens

Use a denture flask (4.2.3) for specimen production with denture base polymer Type 1, and set the mounted teeth in dental gypsum (See 4.2.6). Remove the metal form and then flush the wax from the teeth with boiling tap-water. Prepare and process the denture base polymer to the teeth in accordance with the manufacturer's instructions.

5.2 Test procedure

Fix the polymer-mounted teeth in a mounting device (4.2.11). Use a universal testing machine (4.2.12) with a cylindrical flat shear pin (4.2.13) for the application of the load (see Figure 4). Use a guided shear-pin.

The load direction shall be on the palatal surface of the polymer tooth, vertical (approx. 90°) to the long axis of the tooth.

The shear pin shall with half of its area contact and apply the load on the incisal edge of the tooth.

The test equipment shall prevent any lateral deflection or change of position of the specimen.

Apply a crosshead speed of 1 mm/min until the specimen fractures.

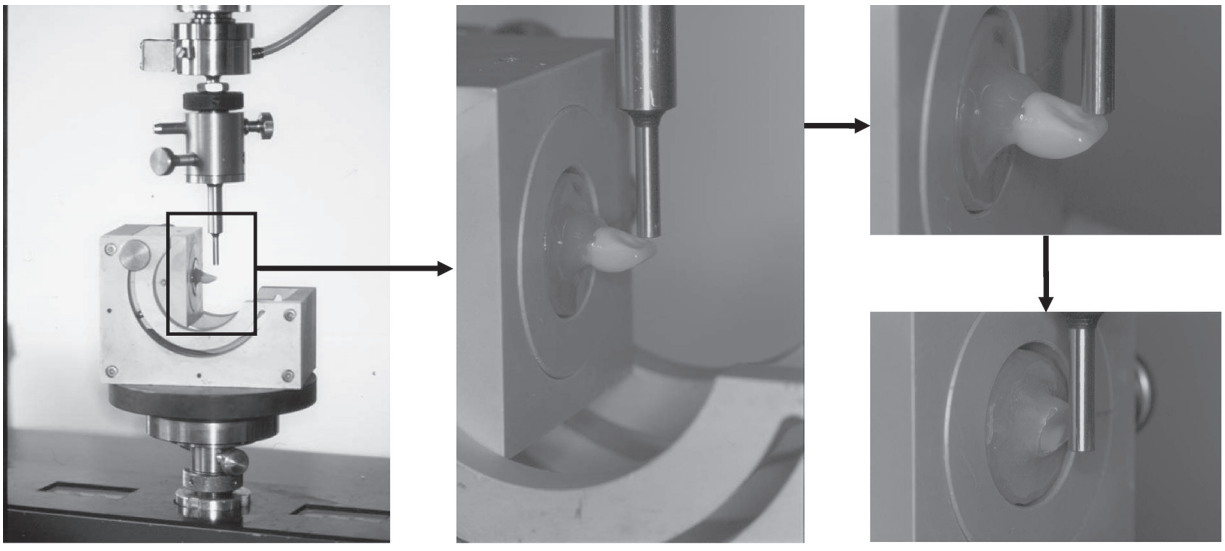


Figure 4 — Application of load to the specimen

5.3 Evaluation

Examine the fracture surfaces under a microscope with 10× magnification.

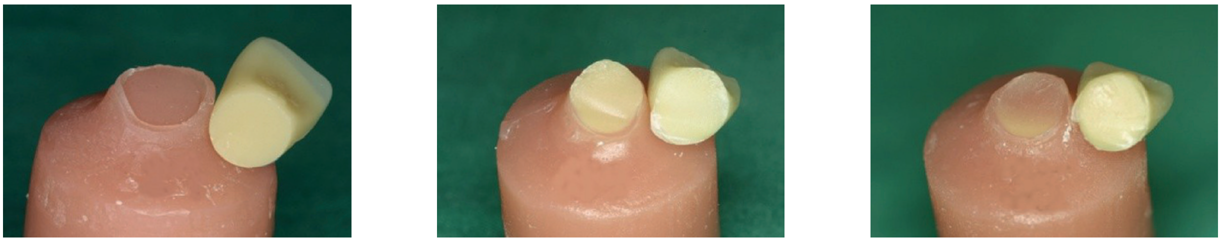
If the fracture path runs cleanly along the interface between teeth and base material it is an adhesive fracture.

If the fracture path does not run cleanly along the interface between tooth and base material it is a cohesive fracture. This means tooth remnants remain bonded to the denture base polymer or there are remnants of denture base polymer remaining bonded to the tooth.

If the fracture path is partially adhesive and cohesive it is a mixed fracture.

NOTE 1 Cohesive fracture in either the tooth or the denture base material is necessary for a satisfactory bond.

Determine the mode of bond failure for each specimen as adhesive fracture or cohesive fracture or mixed fracture (see Figure 5).



a) adhesive fracture b) cohesive fracture c) mixed fracture

Figure 5 — Pictures of failure mode

The sample passes the test successfully if it shows a cohesive or mixed fracture.

Evaluate the fracture behaviour for all test specimens. If four out of six specimens show a cohesive or mixed fracture the bond passes the test. Report the failure mode.

6 Test report

The test report shall include at least the following items:

a) complete identification of the tested polymer teeth, including name, manufacturer, article number, batch number;

b) complete identification of the tested denture base material, including name, manufacturer, article number, batch number, and type of tested denture base material in accordance with ISO 20795-1;

c) processing conditions for specimen preparation;

d) number of tested specimens;

e) number of teeth within the different categories (adhesive, cohesive, mixed);

f) conclusions of the test;

g) any circumstances or conditions thought likely to affect the results or their validity;

h) any deviation from the test method specified;

i) reference to this document, i.e. ISO 19736;

j) name of the responsible person and the testing laboratory;

k) all details necessary to identify the person who carried out the test and the examiner;

l) dates of the test period;

