
**Dentistry — Determination of the
strength of dental amalgam by the
Hertzian indentation strength (HIT)
method**

*Médecine bucco-dentaire — Détermination de la résistance des
amalgames dentaire par l'indentation hertzienne (HIT) méthode*

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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).

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 106, *Dentistry*, Subcommittee SC 1, *Filling and restorative materials*.

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Introduction

This document gives the practical details of the test method for the measurement of the strength of a dental amalgam by the Hertzian indentation (HIT) method. In this test, the specimen geometry and the localized application of force leads to radial crack formation at the surface opposite the one to which the force is applied and under the point at which it is applied. This protocol produces a loading condition similar to that encountered during normal oral function.

When a requirement is agreed, it is the intention of ISO/TC 106/SC 1 to consider the inclusion of this test procedure in the ISO standards for dental amalgam.

This method for measuring the strength of a brittle material (and materials that have very low plasticity) can be applied to other dental restorative materials.

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Dentistry — Determination of the strength of dental amalgam by the Hertzian indentation strength (HIT) method

1 Scope

This document gives the practical details of the test method for the measurement of the strength of a dental amalgam by the Hertzian indentation strength test (HIT) method.

It is applicable to dental amalgam formed from products that are within the scope of ISO 24234 and ISO 20749.

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 6344-1, *Coated abrasives — Grain size analysis — Part 1: Grain size distribution test*

ISO 7488, *Dental amalgamators*

ISO 13565-2, *Geometrical Product Specifications (GPS) — Surface texture: Profile method; Surfaces having stratified functional properties — Part 2: Height characterization using the linear material ratio curve*

ISO 13897, *Dentistry — Amalgam capsules*

ISO 24234, *Dentistry — Dental amalgam*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1942 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

dental amalgam alloy

alloy in fine particles, composed mainly of silver, tin and copper, which, when mixed with *dental mercury* (3.2), produces a dental amalgam

3.2

dental mercury

mercury supplied for use in the preparation of dental amalgam

3.3 pre-encapsulated dental amalgam product

dental amalgam product supplied in a sealed capsule that contains measured amounts of *dental amalgam alloy* (3.1) powder and *dental mercury* (3.2) with masses that are appropriate for the production of a mass of dental amalgam that is considered to be suitable for a single small or medium size restoration in a single tooth

Note 1 to entry: The dental amalgam alloy powder and dental mercury are separated by a barrier that is broken immediately prior to mixing to allow their contact. The capsule remains sealed until mixing has been completed.

3.4 dental amalgam alloy tablet

dental amalgam alloy (3.1) powder that has been compressed to form a single entity for the purpose of providing a pre-dosed quantity of the alloy that, when mixed with an appropriate mass of *dental mercury* (3.2), produces a mass of dental amalgam that is considered to be suitable for a single small or medium size restoration in a single tooth

Note 1 to entry: During mixing, the tablet is intended to break apart, forming a fine powder.

3.5 dental mercury sachet

measured quantity of *dental mercury* (3.2) supplied in a sachet (for use in a reusable mixing capsule) in a mass that, when mixed with an appropriate mass of *dental amalgam alloy* (3.1), produces a mass of dental amalgam that is considered to be suitable for a single small or medium size restoration in a single tooth

Note 1 to entry: The sachet is intended to rupture during mixing to allow the dental mercury to come into contact with the dental amalgam alloy.

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3.6 top surface of the test-piece

surface of the disc shaped test-piece that has been produced by carving back unset amalgam that is above the level of the mould until the surface of the test-piece is flat and level with that mould surface

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3.7 test surface of the test-piece

surface of the disc-shaped test-piece that has been produced by contact with the polished glass plate when the mixed amalgam is packed into the mould

3.8 radial cracking

fracture pattern of Hertzian indentation test-piece disc in which (more or less) planar cracks form along radii, normal to the face of the disc, thus dissecting it into two or more sectors

EXAMPLE Some radial fracture patterns in disc shaped test-pieces are illustrated here.



Note 1 to entry: Such radial cracks initiate on the test surface of the test-piece and propagate through the disc to produce approximately equiangular dissection in most cases.

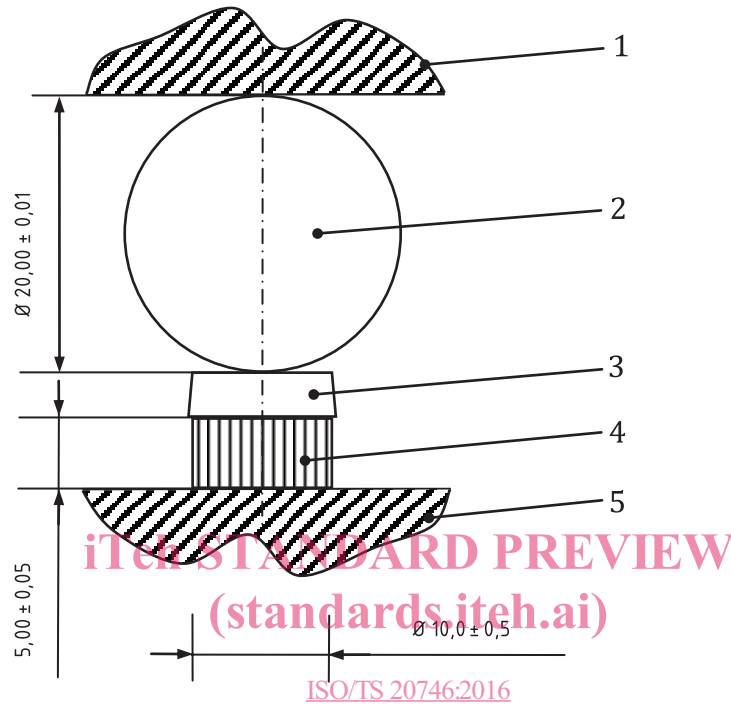
4 Hertzian indentation strength test (HIT) applied to dental amalgam

This test utilizes a disc-shaped test-piece to which a linearly increasing force is applied through a hard steel ball sited at the centre of one of the flat faces of the disc. The other face of the disc is in contact with a smooth substrate that is also disc shaped and thicker than the test-piece. The substrate has a Young's modulus value that is of the same order as that of dentine. Fracture is produced by radial cracks initiating at the surface in contact with the substrate. By having close control of the test-piece, the

resistance to fracture is quantified by the fracture force. Dental amalgam products are compared using the values of the fracture force.

A vertical section through the apparatus required for testing is shown in [Figure 1](#).

Dimensions in millimetres



Key

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- 1 universal mechanical testing machine upper-compression platen
 - 2 chrome steel bearing ball
 - 3 dental amalgam test-piece (see [Figure 2](#) for the dimensions and dimensional tolerances for this)
 - 4 30 % glass-filled polyamide disc
 - 5 universal mechanical testing machine lower compression platen

Figure 1 — Loading arrangement for the Hertzian indentation strength test (HIT)

5 Apparatus for the production of test-pieces

5.1 Equipment

5.1.1 Mould, as shown in [Figure 2](#).

5.1.2 Flat square scratch-free polished **glass plate** with an edge length greater than 30 mm.

5.1.3 Glass **microscope slide** to provide a straight edge to carve back the dental amalgam.

5.1.4 **Hand-instrument for dental amalgam packing.**

5.1.5 **Dental amalgam mechanical mixer.**