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**Dentistry — Dental furnace —**

Part 2:

**Test method for evaluation of furnace  
programme via firing glaze**

*Médecine bucco-dentaire — Four dentaire —*

*Partie 2: Méthode d'essai pour l'évaluation des programmes des fours  
dentaires avec le degré de calcination*

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# Contents

	Page
Foreword .....	iv
Introduction .....	v
<b>1 Scope .....</b>	<b>1</b>
<b>2 Normative references .....</b>	<b>1</b>
<b>3 Terms and definitions .....</b>	<b>1</b>
<b>4 Test method .....</b>	<b>2</b>
4.1 Materials .....	2
4.2 Devices .....	3
4.3 Preparation of the test specimens .....	4
4.4 Firing .....	5
4.4.1 Implementation .....	5
4.4.2 Firing data of the dental ceramic manufacturer .....	6
4.5 Evaluation of the firing results .....	6
4.6 Correction .....	7
<b>5 Test report .....</b>	<b>8</b>
<b>Bibliography .....</b>	<b>9</b>

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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 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](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is ISO/TC 106, *Dentistry*, Subcommittee SC 2, *Prosthetic materials*.

A list of all parts in the ISO 13078 series can be found on the ISO website.

## Introduction

Dental furnaces are suitable for the manufacturing of metal-ceramic and partly also all-ceramic restorations for use in dentistry. Dental furnaces are particularly used for firing or sintering, respectively, of dental opaques, dentine and enamel materials to the respective compatible substructure materials. According to the current state of the art, the temperature of this process lies between 600 °C and 1 000 °C.

The different calibration processes applied by the manufacturers of dental furnaces as well as the varying construction types of the dental furnaces currently on the market influence the firing result.

Despite the fact that different dental furnaces can have identical digital external displays, different results regarding the degree of firing can be identified when processing the same ceramics under otherwise similar conditions.

A different degree of firing not only causes differences that can be judged directly by the human eye (e.g. colour and transparency), but also deviations that cannot be detected by the eye. These are, for instance, the linear coefficient of thermal expansion, the bonding strength, the strength values and the acid solubility. Such changes may result in clinical failures (e.g. fractures) as well as changed aesthetics of the dental ceramic restoration.

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# Dentistry — Dental furnace —

## Part 2:

# Test method for evaluation of furnace programme via firing glaze

## 1 Scope

This document determines a degree of firing to be implemented by the user. It represents a test method for adapting the firing program of a dental furnace by determining the degree of firing of fired test specimens for a dental ceramic.

The test method is suitable for powdered dental ceramics according to ISO 6872, Type I.

The test method enables monitoring of the temperature control in the dental furnace by evaluating the firing degree of a dental ceramic. The test method is also suitable for evaluating the reproducibility of the firings in a dental furnace or for comparing several dental furnaces.

## 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 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 13078, *Dentistry — Dental furnace — Test method for temperature measurement with separate thermocouple*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1942, ISO 6872, ISO 9693-1 and ISO 13078 and the following apply.

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

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

### 3.1

#### degree of firing

surface or edge state of a dental ceramic, which has been treated thermally (i.e. fired, sintered) according to definite firing instructions and which enables statements concerning the physical properties to be evaluated with the eye, such as transparency, colour, surface quality (roughness or smoothness) as well as shrinkage and edge stability of the test specimen

Note 1 to entry: The degree of firing of dental ceramics is differentiated into under-fired, correctly fired and over-fired.

### 3.2

#### **under-fired dental ceramic**

dental ceramic with significant porosities, observable inadequate translucence and still indistinct colour, whose appearance is milky and grey-white opaque and with a surface that is rough and without lustre

Note 1 to entry: No transparency or inadequate colour impression can, however, also result in smooth surfaces as a result of residual porosities inside the specimen.

Note 2 to entry: The best evaluation of under-fired dental ceramics is possible in the case of very transparent colour-intensive dental ceramics.

Note 3 to entry: Although test specimens that are heated too quickly up to the maximum firing temperature exhibit a highly lustrous surface, the inside is milky opaque. These specimens are also under-fired inside.

### 3.3

#### **correctly fired dental ceramic**

dental ceramic without porosities, whose surface does not exhibit any opaqueness, and with slightly rounded edges

Note 1 to entry: Colour and transparency correspond to a standard specimen or the reference sample of the relevant manufacturer.

### 3.4

#### **over-fired dental ceramic**

dental ceramic without porosities, whose surface exhibits a high lustre and whose edges are significantly rounded

### 3.5

#### **reference sample**

correctly fired comparison sample of a dental ceramic (provided by manufacturer of veneering ceramic)

## 4 Test method

### 4.1 Materials

**4.1.1 Dental ceramic material**, powdered, transparent and possibly coloured (e.g. blue), from the existing range for visual comparison with a specimen specified as standard or a reference sample.

**4.1.2 Liquid**, e.g. alcohol, water according to ISO 3696, grade 3, mixing liquid.

**4.1.3 Firing tray**.

**4.1.4 Firing pins** about 12 mm long.

**4.1.5 Firing underlay**, e.g. **firing cotton** about 20 mm × 20 mm × 3 mm or **platinum foil** about 20 mm × 20 mm × 0,03 mm or similar firing underlay.

**4.1.6** Only when using the platinum foil in [4.1.5](#): For the coating of the platinum foil: **Aluminium oxide powder (Al<sub>2</sub>O<sub>3</sub> powder)**, e.g. Bikorit.<sup>1)</sup>

**4.1.7** Reference sample (provided by the manufacturer of veneering ceramic).

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1) Bikorit is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

## 4.2 Devices

### 4.2.1 Dental furnace.

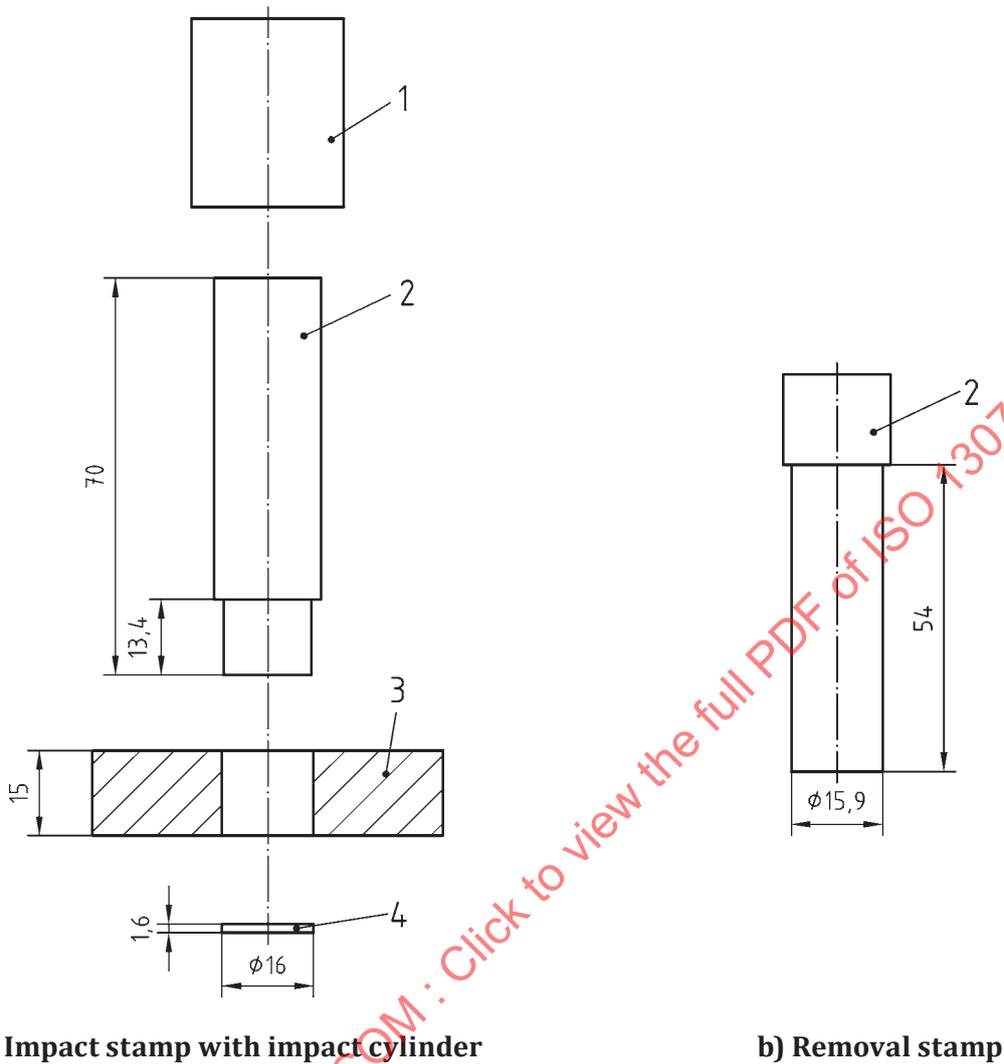
4.2.2 Device for preparation of the test specimens, e.g. according to [Figure 1](#), consisting of

- impact cylinder (1): made from a copper-zinc alloy,  $\varnothing$  30 mm, 30 mm long,
- impact stamp (2): metal stamp made from stainless austenitic steel (e.g. V2A steel), length 70 mm,  $\varnothing$  18 mm with a working end  $\varnothing$  16 mm,
- plastic mould (3): e.g. made from Miramit, Ertacetal or Polyacetal,<sup>2)</sup>  $\varnothing$  50 mm, 20 mm thick, with cylindrical continuous bore ( $\varnothing$  16 mm),
- removal stamp: metal stamp made from stainless austenitic steel (e.g. V2A steel), length 70 mm,  $\varnothing$  15,9 mm, and
- metal base, 150 mm  $\times$  75 mm  $\times$  20 mm (e.g. mixing plate for cements).

NOTE Other suitable devices for preparation of the test specimens can also be used.

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2) Miramit, Ertacetal and Polyacetal are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.



**Key**

- 1 impact cylinder
- 2 impact stamp
- 3 plastic mould
- 4 test specimen

**Figure 1 — Device for preparation of the test specimens**

**4.3 Preparation of the test specimens**

A device according to [Figure 1](#) or a similar suitable device shall be used for the preparation of the test specimens. Test specimens and reference samples to be compared shall be prepared using identical devices.

Cylindrical test specimens with a diameter of 16 mm and a thickness of 1,6 mm can be prepared using this device.

For this purpose, the plastic mould ([Figure 1](#), key 3) shall be placed on the impact stamp with the narrow end pointing upwards, so that a depression results. The dental ceramic material previously doughed corresponding to the manufacturer data shall be added in excess to this depression. By

gently impinging the entire arrangement onto the underlay, the doughed compound shall be pre-compacted; the emerging liquid is fully sucked up with an absorbent cloth. The mould together with impact stamp shall then be placed upside down on the metal base and the doughed compound shall be finally compacted by knocking two to three times with the impact cylinder onto the impact stamp. At the same time, the excess is pressed out to the sides between the metal base and plastic mould and can be brushed off. The impact stamp shall now be removed by a rotational movement upwards. The test specimen shall be pressed out of the mould from below with the removal stamp and then pushed onto a sheet of paper placed at the side.

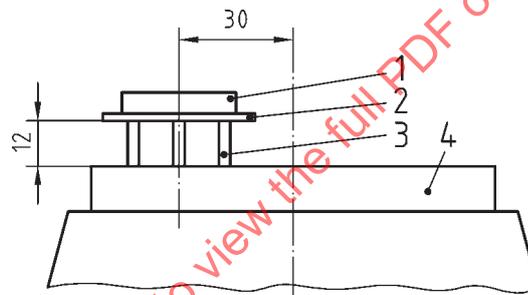
Depending on every preparation of a test specimen, the mould and accessories shall be cleaned under flowing water and then dried.

## 4.4 Firing

### 4.4.1 Implementation

The test specimen is positioned on firing pins and a firing underlay (e.g. firing cotton or platinum foil) at a distance of 30 mm to the firing chamber centre (see [Figure 2](#)). In order to minimize the effect of the firing tray on the firing specimen, the test specimen shall be decoupled from the firing tray using firing pins.

Dimensions in millimetres



#### Key

- 1 test specimen
- 2 firing underlay
- 3 firing pin
- 4 firing tray

NOTE The dimensions are reference values (i.e. possible values) and not absolute values.

**Figure 2 — Positioning of the test specimen on the firing tray**

The platinum foil shall be coated with aluminium oxide powder.

The firing tray with the test specimen shall be positioned in the centre of the firing table.

The firings are carried out according to the firing data of the dental ceramic manufacturer (see [4.4.2](#)) for the dentine and glaze firing. All variables not indicated shall be kept constant for this. This also applies to the respective firing tray used.

The firing control for the test specimens can deviate from the firing control for restorations. Corresponding notes of the dental ceramic manufacturer shall be observed.

Only the maximum firing temperature and/or the heating time are changed during the correction firings for the adaptation in the firing degree of the test specimens. The other variables are kept constant (see [Figure 4](#)).

#### 4.4.2 Firing data of the dental ceramic manufacturer

The manufacturer of the powdered dental ceramic shall provide the following data:

- a) type of dental furnace;
- b) firing data for a standard specimen;
- c) readiness temperature (pre-drying temperature);
- d) heating rate or heating time under negative pressure (vacuum);
- e) negative pressure (vacuum);
- f) firing temperature;
- g) holding time of the firing temperature.

#### 4.5 Evaluation of the firing results

The firing results shall be evaluated by a visual comparison with the reference sample, e.g. using [Figure 4](#).

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