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Dentistry — Machinable ceramic blanks

Médecine bucco-dentaire — Ébauches en céramique usinables

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Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**
3.1 Materials ... 1
3.2 Properties ... 2
3.3 Types of blanks ... 2
3.4 Test piece ... 2

4 Homogeneity of partially sintered zirconia blanks ... **3**
4.1 Classification ... 3
4.2 Determination of the shrinkage factor, *d* ... 3
4.2.1 Blanks characterized by one shrinkage factor for all three dimensions in space ... 3
4.2.2 Blanks characterized by two or three shrinkage factors ... 5
4.3 Recommendations ... 6
4.4 Test report ... 6

5 Warpage ... **7**
5.1 Test method ... 7
5.1.1 Large zirconia blanks ... 7
5.1.2 Medium- and small-size zirconia blanks ... 8
5.2 Recommendations ... 8
5.3 Test report ... 9

6 Dimensional stability post machining crystallization of glass ceramics ... **9**
6.1 General ... 9
6.2 Test method ... 9
6.2.1 Sample preparation ... 9
6.2.2 Characterization before heat treatment ... 10
6.2.3 Heat treatment ... 11
6.2.4 Characterization after heat treatment ... 11
6.3 Test report ... 12

7 Machining damage ... **13**
7.1 General ... 13
7.2 Test methods ... 13
7.3 Test report ... 13

8 Machinability using the merlon fracture test ... **14**
8.1 General ... 14
8.2 Test method ... 15
8.2.1 Dimensions of test geometries ... 15
8.2.2 Machining ... 16
8.2.3 Characterization of milled specimen ... 16
8.3 Recommendations ... 17
8.4 Test report ... 17

Bibliography ... **19**

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Foreword

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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).

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This document was prepared by Technical Committee ISO/TC 106, *Dentistry*, Subcommittee SC 9, *Dental CAD/CAM systems,* 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).

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.

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Introduction

A variety of ceramic blank materials are being used in machining systems for fabrication of various restorations. Although all these materials can have different chemical and microstructural makeup, there are some unique and common concerns for machining and performance of these materials. Machining damage, minimum machined thickness, and machining tolerances all are common concerns for these materials.

The overwhelming use of zirconia and alumina is in the form of green or partially sintered blanks with shrinkage values of 20 % to 35 % by volume when sintered to full density. In order for the restoration to be fabricated with proper accuracy, the blank density should be carefully measured and conveyed to the computer controlled milling unit. This allows for proper oversizing and shrinkage to provide an accurate fit. Furthermore, the blank should be homogeneous throughout the body, otherwise differential shrinkage occurs resulting in significant warping and departure from linearity.

With respect to glass ceramics, a subset requires crystallization post-machining during which distortion can occur placing the machined part out of the tolerance specified for the restoration. Also, another subset is machined in the crystallized state that can cause significant machining damage affecting the properties of the material.

The machining process can cause surface and subsurface damage that can decrease the flexural strength of the material. Furthermore, damage can limit the minimum thickness of the material that can be achieved with the machining process and affect the accuracy of the final part with respect to the original designed dimensions.

This document provides guidance for evaluating the effects of machining on ceramic materials, the dimensional changes occurring after crystallization and after sintering, and assessing machining damage.

Specific qualitative and quantitative recommendations for freedom from biological hazard are not included in this document, however when assessing possible biological or toxicological hazards, reference should be made to ISO 10993-1 and ISO 7405. Basic material properties are not included in this document, however when assessing material properties, reference should be made to ISO 6872.

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Dentistry — Machinable ceramic blanks

1 Scope

This document specifies test methods for machinable ceramic blanks used for the fabrication of dental fixed restorations. This document also specifies the contents of the test report.

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 6872, *Dentistry — Ceramic materials*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1942, ISO 6872 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 Materials

3.1.1
feldspathic ceramic
inorganic, non-metallic material which is predominantly a glassy material that consists of aluminum silicates with either potassium, sodium or calcium

3.1.2
polymer infiltrated ceramic
dental ceramic which is an interconnected network of a ceramic and polymer formed by infiltration of a porous ceramic network with a monomer

3.1.3
zirconia
ZrO_2
oxidized form of the metal zirconium (Zr), exhibiting three well-defined crystal structures (polymorphs or phases) that can be monoclinic, tetragonal or cubic

3.1.4
glass ceramic
material manufactured by melting a glass, cooling it to the amorphous state, forming nuclei by controlled heat treatment and then growing the nuclei into the crystalline phase(s) by a second controlled heat treatment

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3.2 Properties

3.2.1
homogeneity
degree to which the density and properties are uniform throughout the entirety of the dental blank

3.2.2
shrinkage factor
volumetric or linear change in dimension during sintering of a *green blank* (3.3.1) or a *partially sintered blank* (3.3.2) as labelled with a bar code or stated in the packaging

3.2.3
warpage
degree to which sections of the *fully dense blank* (3.3.3) or *partially sintered blank* (3.3.2) has a uniform flat surface after final sintering to full density or post machining processing

3.2.4
machining damage
effect on surface and sub surface structure occurring during machining the blank to form the final part or device

3.2.5
crystallization distortion
change in dimension of the machined part due to crystallization from a glass or a partially crystallized glass ceramic to a fully crystallized glass ceramic

3.2.6
minimum machined thickness
minimum thickness that an intact part can be machined from a given blank of material

3.2.7
machinable ceramic blank
piece of material subjected to subtractive methods to remove material from the piece leaving the final desired part

3.3 Types of blanks

3.3.1
green blank
blank in which powder has been pressed or cast to form the structure

3.3.2
partially sintered blank
blank which has been subjected to heating to cause partial sintering of the blank resulting in a blank with improved mechanical properties but that is still porous and not fully dense

3.3.3
fully dense blank
blank which has been subjected to heating to cause full sintering of a ceramic powder to achieve full density such as feldspathic, leucite and glass ceramic materials

3.4 Test piece

3.4.1
merlon
free standing wall of the test piece after the milling

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