



Revised American National Standard/
American Dental Association
Standard No. 69

Dental Ceramic

Identical adoption of ISO 6872:2015, *Dentistry— Ceramic materials*



Standards Committee on Dental Products

2017

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REVISED AMERICAN NATIONAL STANDARD/AMERICAN DENTAL ASSOCIATION STANDARD NO. 69 FOR DENTAL CERAMIC

The ADA Standards Committee on Dental Products (SCDP) has approved Revised ANSI/ADA Standard No. 69 for Dental Ceramic. This and other standards for dental materials, instruments and equipment are being formulated by working groups of the ADA SCDP. The Committee has representation from all interests in the United States in the standardization of materials, instruments and equipment in dentistry. The Committee has adopted the standards, showing professional recognition of their usefulness in dentistry, and has forwarded them to the American National Standards Institute with a recommendation that the standards be approved as American National Standards. The American National Standards Institute granted approval of ADA Standard No. 69 as an American National Standard on December 21, 2017.

The ADA Standards Committee on Dental Products thanks the members of Working Group 2.20 Porcelain and Metal-Ceramic Systems and the organizations with which they were affiliated at the time the specification was developed:

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FOREWORD

(This Foreword does not form a part of Revised ANSI/ADA Standard No. 69 for Dental Ceramic).

This standard is an identical adoption of ISO 6872:2015, Dentistry – Ceramic materials. ADA SCDP Working Group No. 2.20 on Porcelain and Metal-ceramic Systems examined the international standard and found it acceptable for identical adoption as revised ANSI/ADA Standard No. 69.

The proposed revision of ANSI/ADA Standard No. 69 for Dental Ceramic cancels and replaces ANSI/ADA Standard No. 69:2010 (R2015), which was an identical adoption of ISO 6872:2008.

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INTRODUCTION

Specific qualitative and quantitative requirements for freedom from biological hazard are not included in this standard, but it is recommended that in assessing possible biological or toxicological hazards, reference be made to ADA Standard No. 41, ISO 10993-1 and ISO 7405.

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1 Scope

This Standard specifies the requirements and the corresponding test methods for dental ceramic materials for fixed all-ceramic and metal-ceramic restorations and prostheses.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 1942, *Dentistry — Vocabulary*

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

ISO 7500-1 *Metallic materials – Calibration and verification of static uniaxial testing machines – Part 1: Tension/compression testing machines – Calibration and verification*

(ISO standards are available from the American National Standards Institute, 25 W. 43rd St., New York, NY 10036 or www.ansi.org).

3 Terms and definitions

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

3.1 Material

3.1.1

addition ceramic

add-on ceramic

correction ceramic

dental ceramic material which is fired at a reduced temperature and is normally applied to restore contact areas on a dental restoration or prosthesis

3.1.2

aesthetic ceramic

dental porcelain (3.1.5) or *glass ceramic* (3.1.10) having appropriate translucency and color used to mimic the optical properties of natural teeth

3.1.3

chromatic dentin ceramic

dentine ceramic having a high strength or saturation of the hue (color)

3.1.4

dental ceramic

inorganic, non-metallic material that is specifically formulated for use when processed according to the manufacturers' instructions to form the whole or part of a dental restoration or prosthesis

3.1.5

dental porcelain

predominantly, glassy *dental ceramic* (3.1.4) material used mainly for aesthetics in a dental restoration or prosthesis

3.1.6

dentine ceramic

dental ceramic (3.1.4) material used to form the overall shape and basic color of a dental restoration or prosthesis simulating the natural tooth dentine

3.1.7

enamel ceramic

dental ceramic (3.1.4) material used to overlay, either partially or wholly, the *dentine ceramic* (3.1.6) and also, to form the more translucent incisal third of a dental restoration or prosthesis simulating the natural tooth enamel

3.1.8

flame-sprayed dental ceramic

dental ceramic core or substructure layer formed via the technique of flame-spraying

3.1.9

fluorescent ceramic

dental ceramic (3.1.4) material that absorbs radiant energy and emits it in the form of radiant energy of a different wavelength band all or most of whose wavelengths exceed that of the absorbed energy

EXAMPLE Absorption of ultraviolet light with emission of blue light.

3.1.10

glass ceramic (dental)

dental ceramic (3.1.4) material formed by the action of heat treatment on a glass in order to cause initiation and growth of a wholly or predominantly crystalline microstructure

3.1.11

glass-infiltrated dental ceramic

dental ceramic core or substructure layer that is porous and is subsequently densified by the infiltration of specialized glass at elevated temperature

3.1.12

glaze ceramic

dental ceramic (3.1.4) material which is overlaid and fired at a lower temperature compared to *dentine ceramic* (3.1.6) or *enamel ceramic* (3.1.7) to produce a thin coherent sealed surface, the level of gloss being determined by the firing conditions

3.1.13

liner

dental ceramic (3.1.4) material used on all ceramic substructure forming a layer that provides a background color upon which dentine or opaceous dentine can be applied to achieve overall aesthetics

3.1.14

modelling fluid

liquid with which a dental ceramic powder is mixed in order to shape or model it into its required form prior to firing

3.1.15

modifying enamel ceramic

enamel ceramic (3.1.7) used to modify the surface contour of a restoration, for example, add a contact, often fired at a lower temperature than the enamel ceramic or dentine ceramic

3.1.16

monolithic ceramic

dental ceramic (3.1.4) that is substantially made of a single uniform material

Note 1 to entry: A thin layer of *glaze* (3.3.4) (staining technique) can be applied.

3.1.17

opaque dentine ceramic

dental ceramic (3.1.4) material having a higher opacity than a *dentine ceramic* (3.1.6) material, but which can still be used to contribute to the overall shape and basic color of a dental restoration or prosthesis simulating the natural tooth dentine

3.1.18

opalescent enamel ceramic

enamel ceramic (3.1.7) material that scatters shorter wavelengths of light (e.g. blue) and transmits longer wavelengths of light (e.g. red)

3.1.19

opaque dental ceramic

dental ceramic (3.1.4) material, which, when applied to a metallic substructure, according to the manufacturer's instructions, acts to bond to the metal surface, forming a layer that provides a background color and interface upon which other dental ceramic materials can be applied to achieve overall aesthetics

3.1.20

shoulder ceramic

margin ceramic

dental ceramic (3.1.4) material used to form shape and color at the marginal area of the dental restoration or prosthesis simulating natural tooth dentine in this area

3.1.21

stain ceramic

dental ceramic powder or paste which is normally intensely colored and which is formulated to be used either internally or externally during the build-up of a dental restoration or prosthesis to simulate details within or on the surface as are found in natural teeth

3.1.22

substructure (core) dental ceramic

predominantly, polycrystalline dental ceramic material that forms a supporting substructure upon which one or more layers of *dental ceramic* (3.1.4) or dental polymer material are applied, either partially or totally, to form a dental restoration or prosthesis

3.2 Processing

3.2.1

air firing dental ceramic

firing of *dental ceramics* (3.1.4) under ambient atmospheric pressure

3.2.2

dental CAD/CAM

computer-aided design/computer-aided manufacture (CAD/CAM) procedures to manufacture a dental restoration or prosthesis normally including the following stages: a) a digital scanning procedure of the

model, wax-up, or intra-orally to produce a 3D data set; b) software manipulation of the 3D data set to design the prosthesis; c) a computer-directed machine tool that performs the manufacturing process

3.2.3

condensation of dental ceramic

powder process whereby a slurry of dental ceramic powder is vibrated to compact the powder prior to sintering

3.2.4

injectable, castable, or pressable dental ceramic

dental ceramic (3.1.4) material, normally in the form of a pellet or ingot (often pre-sintered), designed for use in a specialised furnace which enables the ingot to be injected/cast/pressed into a mold prepared through the lost wax technique

3.2.5

sintering of a dental ceramic

process whereby heat and potentially other process parameters, for example, mechanical or gas pressure, are applied to a ceramic powder or powder compact in order to densify the ceramic into its required form

Note 1 to entry: “Firing” and “sintering” are used interchangeably in this Standard (“firing” connoting the application of heat to drive sintering).

3.2.6

vacuum firing dental ceramic

firing of *dental ceramics* (3.1.4) at reduced pressure (i.e. under vacuum) to yield the required density and associated aesthetics especially the degree of translucency

Note 1 to entry: Dental ceramics for vacuum firing have a specific particle size distribution to reduce the entrapment of porosity.

3.3 Properties

3.3.1

class of dental ceramic

classification of a *dental ceramic* (3.1.4) material according to its intended function

3.3.2

fracture toughness

conventional fracture mechanics parameter indicating the resistance of a material to crack extension (propagation)

3.3.3

glass transition temperature

approximate midpoint of the temperature range over which a glass transforms between elastic and viscoelastic behaviour characterized by the onset of a rapid change in its coefficient of thermal expansion

3.3.4

glaze

surface appearance obtained when the gloss is clinically and aesthetically acceptable

4 Types, classes, and their identification

For the purposes of this Standard, dental ceramics are designated into two Types.

- Type I: Ceramic products that are provided as powders, pastes, or aerosols.
- Type II: All other forms of ceramic products.

Ceramics are divided into five classes according to their intended clinical use and according to the descriptions in Table 1. If color is added to a ceramic powder for identification purposes, the color coding given in Table 2 is recommended.

Table 1 — Classification of ceramics for fixed prostheses by intended clinical use with required mechanical and chemical properties

Class	Recommended clinical indications	Mechanical and chemical properties	
		Flexural strength [MPa] minimum value for mean (see 7.3.1.4)	Chemical solubility [µg/cm ²]
1	a) Monolithic ceramic for single-unit anterior prostheses, veneers, inlays, or onlays adhesively cemented.	50	<100
	b) Ceramic for coverage of a metal framework or a ceramic substructure.	50	<100
2	a) Monolithic ceramic for single-unit anterior or posterior prostheses adhesively cemented.	100	<100
	b) Partially or fully covered substructure ceramic for single-unit anterior or posterior prostheses adhesively cemented.	100	<2 000
3	a) Monolithic ceramic for single-unit anterior or posterior prostheses and for three-unit prostheses not involving molar restoration adhesively or non-adhesively cemented.	300	<100
	b) Partially or fully covered substructure for single-unit anterior or posterior prostheses and for three-unit prostheses not involving molar restoration adhesively or non-adhesively cemented.	300	<2 000
4	a) Monolithic ceramic for three-unit prostheses involving molar restoration.	500	<100
	b) Partially or fully covered substructure for three-unit prostheses involving molar restoration.	500	<2 000
5	Monolithic ceramic for prostheses involving partially or fully covered substructure for four or more units or fully covered substructure for prostheses involving four or more units.	800	<100

Table 2 — Recommended color coding for the identification of Type I dental ceramic powders

Material	Color coding
Dentine ceramic	Pink
Enamel ceramic	Blue
Fluorescent ceramic	Yellow
Highly chromatic dentine ceramic	Orange
Opalescent enamel ceramic	Blue-green
Modifying enamel ceramic (e.g. translucent, clear)	Purple

5 Requirements

5.1 Uniformity

The inorganic pigment(s) used to produce the color of a fired dental ceramic and any organic colorants (for color coding) shall be uniformly dispersed throughout the dental ceramic material and in powdered ceramic products, no segregation of the pigment(s) shall take place when the powder is mixed as in 7.1.3. Check by visual inspection.

5.2 Freedom from extraneous materials

5.2.1 Dental ceramic materials shall be free from extraneous materials when assessed by visual inspection.

5.2.2 Dental ceramic materials shall not have an activity concentration of more than $1.0 \text{ Bq} \cdot \text{g}^{-1}$ of ^{238}U . Test in accordance with 7.2.2.

5.2.3 Any colorants used to color code the ceramic powder, as per Table 2, are recommended to be food-quality organic materials.

5.3 Mixing and condensation properties of Type I ceramics

When mixed as in 7.1.3 with water or the modelling fluid recommended by the manufacturer, a dental ceramic powder shall neither form lumps, nor granules, when assessed by visual inspection.

The paste formed shall be suitable for making the indicated restorations and prostheses by condensation of successive layers. When the paste is condensed as in 7.1.4, it shall neither crack, nor crumble, when assessed by visual inspection during drying.

5.4 Physical and chemical properties

The physical and chemical properties of ceramic test specimens tested in accordance with the relevant methods detailed for Type I and Type II ceramics in Clause 7 shall comply with the requirements specified in Table 1. The coefficient of thermal expansion of the ceramics shall not deviate by more than $0.5 \times 10^{-6} \text{ K}^{-1}$ from the value stated by the manufacturer (see 8.2.2). The glass transition temperature of the ceramics shall not deviate by more than $20 \text{ }^{\circ}\text{C}$ from the value stated by the manufacturer (see 8.2.2).

5.5 Biocompatibility

See the introduction for guidance on biocompatibility.