



Designation: **F2393–12** **F2393 – 12 (Reapproved 2016)**

Standard Specification for High-Purity Dense Magnesia Partially Stabilized Zirconia (Mg-PSZ) for Surgical Implant Applications¹

This standard is issued under the fixed designation F2393; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers material requirements for high-purity, dense zirconium oxide partially stabilized by magnesium oxide (magnesia partially stabilized zirconia (Mg-PSZ)) for surgical implant applications.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[C373 Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products](#)

[C1161 Test Method for Flexural Strength of Advanced Ceramics at Ambient Temperature](#)

[C1198 Test Method for Dynamic Young's Modulus, Shear Modulus, and Poisson's Ratio for Advanced Ceramics by Sonic Resonance](#)

[C1239 Practice for Reporting Uniaxial Strength Data and Estimating Weibull Distribution Parameters for Advanced Ceramics](#)

[C1259 Test Method for Dynamic Young's Modulus, Shear Modulus, and Poisson's Ratio for Advanced Ceramics by Impulse Excitation of Vibration](#)

[C1327 Test Method for Vickers Indentation Hardness of Advanced Ceramics](#)

[E112 Test Methods for Determining Average Grain Size](#)

2.2 *American Society for Quality Standard (ASQ):*

[C1 Specification of General Requirements for a Quality Program](#)³

2.3 *ISO Standard:*

[ISO 18754 Fine Ceramics \(Advanced Ceramics, Advanced Technical Ceramics\)—Determination of Density and Apparent Porosity](#)⁴

3. Chemical Requirements

3.1 The chemical composition shall be as follows, measured by ICP-ES, XRF, or mass spectroscopy:

Oxides	Weight percent
ZrO ₂ + HfO ₂ + MgO	≥99.8
MgO	3.1-3.4
HfO ₂	≤2.0
Total Other Oxides	<0.20

¹ This specification is under the jurisdiction of ASTM Committee F04 on Medical and Surgical Materials and Devices and is the direct responsibility of Subcommittee F04.13 on Ceramic Materials.

Current edition approved March 1, 2012; October 1, 2016. Published March 2012; October 2016. Originally approved in 2004. Last previous edition approved in 2010 as F2393–10; F2393–12. DOI: 10.1520/F2393-12.10.1520/F2393-12R16.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Society for Quality (ASQ), 600 N. Plankinton Ave., Milwaukee, WI 53203, <http://www.asq.org>.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.



Other Oxides	
Fe ₂ O ₃	<0.01
SiO ₂	<0.05
CaO	<0.02
Al ₂ O ₃	<0.05

NOTE 1—The radioactivity, defined as the sum of the massic activity of U238, Ra226, Th232, and determined by γ -spectroscopy on the ready-to-use powder, should be less than 200 Bq/Kg.

4. Physical Requirements

4.1 The minimum bulk density of magnesia partially stabilized zirconia shall be 5.800 g/cm³ as determined by Test Method C373 as supplied, with the following modifications or by ISO 18754.

4.1.1 Weight determination per sections 3.1 and 5.1 of Test Method C373 and section 7.1 of ISO 18754 shall be made such that it can be calculated and reported to four significant figures.

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