



Standard Practice for Fabricating Non-Oxide Ceramic Reference Specimens Containing Seeded Inclusions¹

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1. Scope

1.1 This practice covers a procedure for fabricating both green and sintered test samples of silicon carbide and silicon nitride containing inclusions. These samples can be used to determine the sensitivity and detection capability of a nondestructive examination (NDE) method.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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 limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

B 311 Test Method for Density Determination for Powder Metallurgy (P/M) Materials Containing Less Than Two Percent Porosity²

C 373 Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products³

3. Terminology

3.1 Descriptions of Terms Specific to This Standard:

3.1.1 *green specimen*—formed ceramic specimens as originally compacted prior to high-temperature densification.

3.1.2 *inclusion*—a solid discontinuity in a specimen, with a composition not that of the specimen.

3.1.3 *seeded inclusions*—discontinuities intentionally placed at prescribed locations in reference specimens.

3.1.4 *sintered specimen*—formed ceramic specimen after firing to densify and remove solvents or binders.

4. Significance and Use

4.1 This practice describes a method of fabrication of known discontinuities in a ceramic specimen. Such specimens

are needed and used in nondestructive examination to demonstrate sensitivity and resolution and to assist in establishing proper examination parameters.

5. Apparatus

5.1 *Aerosol Duster*, moisture-free.

5.2 *Die*, capable of exerting pressure up to 120 MPa and will not contaminate the compacted material.

5.3 *Optical Magnifier*, capable of providing 10 to 30× magnification.

5.4 *Tubing*, latex, thin-wall, for encapsulating compact during isopressing.

5.5 *Carver Press*, or similar type of apparatus capable of exerting the necessary pressure to consolidate the sample.

5.6 *Cold Isostatic Press*, capable of maintaining 500 MPa.

5.7 *Oven or Furnace*, which can maintain a temperature of 500°C.

5.8 *Imaging Equipment*, with the capability of producing a hard copy output of the image (that is, 35 mm camera, charge coupled device (CCD) camera outputted to a video printer, a stereo microscope with 4 by 5 instamatic film, etc.).

5.9 *Sintering Furnaces*, capable of reaching temperatures of 1400 to 2200°C. Depending on the ceramic system chosen, the furnace may be required to operate in a vacuum or under inert gas atmospheres, or both, at pressures as high as 200 MPa.

5.10 *Mettler Scale*, or similar device capable of measuring within 0.01 mg. Measuring densities according to Archimedes principle requires the use of a sample holder suspended in water attached to the scale.

6. Materials

6.1 *Silicon Carbide or Silicon Nitride Powders*, of appropriate purity and particle size, prepared with sintering aids and binder representative of the product to be inspected and in a manner appropriate for dry pressing with granule size less than -100 mesh.

6.2 *Inclusion Spheres*, diameters as needed. Inclusion materials selected based on applicable green and sintered inclusion that is desired to be investigated for a specific silicon nitride or silicon carbide application.

6.2.1 The size, shape, and composition of the inclusions shall be determined a priori before seeding. The inclusion particles must be carefully selected based on the ceramic system of interest and the purpose of the test samples.

¹ This practice is under the jurisdiction of ASTM Committee C-28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.02 on Design and Evaluation.

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² *Annual Book of ASTM Standards*, Vol 02.05.

³ *Annual Book of ASTM Standards*, Vol 15.02.