



Standard Guide for Development of Specifications for Fiber Reinforced Carbon- Carbon Composite Structures for Nuclear Applications¹

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1. Scope

1.1 This document is a guide to preparing material specifications for fiber reinforced carbon-carbon (C-C) composite structures (flat plates, rectangular bars, round rods, and tubes) manufactured specifically for structural components in nuclear reactor core applications. The carbon-carbon composites consist of carbon/graphite fibers (from PAN, pitch, or rayon precursors) in a carbon/graphite matrix produced by liquid infiltration/pyrolysis and/or by chemical vapor infiltration.

1.2 This guide provides direction and guidance for the development of a material specification for a specific C-C composite component or product for nuclear reactor applications. The guide considers composite constituents and structure, physical and chemical properties, mechanical properties, thermal properties, performance durability, methods of testing, materials and fabrication processing, and quality assurance. The C-C composite materials considered here would be suitable for nuclear reactor core applications where neutron irradiation-induced damage and dimensional changes are a significant design consideration. **(1-4)**²

1.3 The component specification is to be developed by the designer/purchaser/user. The designer/purchaser/user shall define and specify in detail any and all application-specific requirements for necessary design, manufacturing, and performance factors of the ceramic composite component. This guide for material specifications does not directly address component/product-specific issues, such as geometric tolerances, permeability, bonding, sealing, attachment, and system integration.

1.4 This guide is specifically focused on C-C composite components and structures with flat panel, solid rectangular bar, solid round rod, or tubular geometries.

1.5 This specification may also be applicable to C-C composites used for other structural applications discounting the nuclear-specific chemical purity and irradiation behavior factors.

1.6 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *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:³

- C242 Terminology of Ceramic Whitewares and Related Products
- C559 Test Method for Bulk Density by Physical Measurements of Manufactured Carbon and Graphite Articles
- C561 Test Method for Ash in a Graphite Sample
- C577 Test Method for Permeability of Refractories
- C611 Test Method for Electrical Resistivity of Manufactured Carbon and Graphite Articles at Room Temperature
- C625 Practice for Reporting Irradiation Results on Graphite
- C709 Terminology Relating to Manufactured Carbon and Graphite
- C714 Test Method for Thermal Diffusivity of Carbon and Graphite by Thermal Pulse Method
- C769 Test Method for Sonic Velocity in Manufactured Carbon and Graphite Materials for Use in Obtaining Young's Modulus
- C816 Test Method for Sulfur in Graphite by Combustion-Iodometric Titration Method
- C838 Test Method for Bulk Density of As-Manufactured Carbon and Graphite Shapes
- C1039 Test Methods for Apparent Porosity, Apparent Specific Gravity, and Bulk Density of Graphite Electrodes

¹ This guide is under the jurisdiction of ASTM Committee C28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.07 on Ceramic Matrix Composites.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ 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.