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Standard Guide for Nondestructive Testing of Polymer Matrix Composites Used in Aerospace Applications¹

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This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This guide provides information to help engineers select appropriate nondestructive testing (NDT) methods to characterize aerospace polymer matrix composites (PMCs). This guide does not intend to describe every inspection technology. Rather, emphasis is placed on established NDT methods that have been developed into consensus standards and that are currently used by industry. Specific practices and test methods are not described in detail, but are referenced. The referenced NDT practices and test methods have demonstrated utility in quality assurance of PMCs during process design and optimization, process control, after manufacture inspection, in-service inspection, and health monitoring.

1.2 This guide does not specify accept-reject criteria and is not intended to be used as a means for approving composite materials or components for service.

1.3 This guide covers the following established NDT methods as applied to PMCs: Acoustic Emission (AE, 7), Computed Tomography (CT, 8), Leak Testing (LT, 9), Radiographic Testing, Computed Radiography, Digital Radiography, and Radioscopy (RT, CR, DR, RTR, 10), Shearography (11), Strain Measurement (contact methods, 12), Thermography (13), Ultrasonic Testing (UT, 14), and Visual Testing (VT, 15).

1.4 The value of this guide consists of the narrative descriptions of general procedures and significance and use sections for established NDT practices and test methods as applied to PMCs. Additional information is provided about the use of currently active standard documents (an emphasis is placed on applicable standard guides, practices, and test methods of ASTM Committee E07 on Nondestructive Testing), geometry and size considerations, safety and hazards considerations, and information about physical reference standards.

1.5 To ensure proper use of the referenced standard documents, there are recognized NDT specialists that are

certified in accordance with industry and company NDT specifications. It is recommended that a NDT specialist be a part of any composite component design, quality assurance, in-service maintenance or damage examination.

1.6 This guide summarizes the application of NDT procedures to fiber- and fabric-reinforced polymeric matrix composites. The composites of interest are primarily, but not exclusively limited to those containing high modulus (greater than 20 GPa (3×10^6 psi)) fibers. Furthermore, an emphasis is placed on composites with continuous (versus discontinuous) fiber reinforcement.

1.7 This guide is applicable to PMCs containing but not limited to bismaleimide, epoxy, phenolic, poly(amide imide), polybenzimidazole, polyester (thermosetting and thermoplastic), poly(ether ether ketone), poly(ether imide), polyimide (thermosetting and thermoplastic), poly(phenylene sulfide), or polysulfone matrices; and alumina, aramid, boron, carbon, glass, quartz, or silicon carbide fibers.

1.8 The composite materials considered herein include uniaxial laminae, cross-ply laminates, angle-ply laminates, and structural sandwich constructions. The composite components made therefrom include filament-wound pressure vessels, flight control surfaces, and various structural composites.

1.9 For current and potential NDT procedures for finding indications of discontinuities in the composite overwrap in filament-wound pressure vessels, also known as composite overwrapped pressure vessels (COPVs), refer to Guide E2981.

1.10 For a summary of the application of destructive ASTM standard practices and test methods (and other supporting standards) to continuous-fiber reinforced PMCs, refer to Guide D4762.

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

1.12 *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.*

¹ This guide is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.10 on Specialized NDT Methods.

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