Designation: E 2582 – 07

Standard Practice for Infrared Flash Thermography of Composite Panels and Repair Patches Used in Aerospace Applications[1]

This standard is issued under the fixed designation E 2582; 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 practice describes a procedure for detecting subsurface flaws in composite panels and repair patches using Flash Thermography (FT), in which an infrared (IR) camera is used to detect anomalous cooling behavior of a sample surface after it has been heated with a spatially uniform light pulse from a flash lamp array.

1.2 This practice describes established FT test methods that are currently used by industry, and have demonstrated utility in quality assurance of composite structures during post-manufacturing and in-service examinations.

1.3 This practice has utility for testing of polymer composite panels and repair patches 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. Typical as-fabricated geometries include uniaxial, cross ply and angle ply laminates; as well as honeycomb core sandwich core materials.

1.4 This practice has utility for testing of ceramic matrix composite panels containing, but not limited to, silicon carbide, silicon nitride and carbon matrix and fibers.

1.5 This practice applies to polymer or ceramic matrix composite structures with inspection surfaces that are sufficiently optically opaque to absorb incident light, and that have sufficient emissivity to allow monitoring of the surface temperature with an IR camera. Excessively thick samples, or samples with low thermal diffusivities, require long acquisition periods and yield weak signals approaching background and noise levels, and may be impractical for this technique.

1.6 This practice applies to detection of flaws in a composite panel or repair patch, or at the bonded interface between the panel and a supporting sandwich core or solid substrate. It does not apply to discontinuities in the sandwich core, or at the interface between the sandwich core and a second panel on the far side of the core (with respect to the inspection apparatus).

1.7 This practice does not specify accept-reject criteria and is not intended to be used as a basis for approving composite structures for service.

1.8 *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:* [2]

D 3878 Terminology for Composite Materials

E 1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 *Definitions*—Terminology in accordance with Terminologies D 3878 and E 1316 and shall be used where applicable.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *aspect ratio*—the diameter to depth ratio of a flaw. For irregularly shaped flaws, diameter refers to the minor axis of an equivalent rectangle that approximates the flaw shape and area.

3.2.2 *discrete discontinuity*—a thermal discontinuity whose projection onto the inspection surface is smaller than the field of view of the inspection apparatus.

3.2.3 *extended discontinuity*—a thermal discontinuity whose projection onto the inspection surface completely fills the field of view of the inspection apparatus.

3.2.4 *first logarithmic derivative*—the rate of change of the natural logarithm of temperature (with preflash temperature subtracted) with respect to the natural logarithm of time.

3.2.5 *inspection surface*—the surface of the specimen that is exposed to the FT apparatus.

3.2.6 *logarithmic temperature-time plot*—a plot of the natural logarithm of the surface temperature with preflash temperature subtracted on the y-axis versus the natural logarithm of time on the x-axis, where time t=0 is taken to be the midpoint of the flash event. Either temperature or radiance may be used to create the plot.

[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.10 on Emerging NDT Methods.

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[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.