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Infrared Thermography (IRT) Inspection of Composites - A Manufacturer's Perspective

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Abstract

Composites are heterogeneous, multi-layered, anisotropic and highly attenuative materials. Composites are highly process and material dependent in terms of the resultant properties and are sensitive to the variations in the process adopted. There are a variety of processes which include filament winding, tape wrapping, compression moulding, matched-die moulding, vacuum bag moulding and so on. Designer will choose a particular process based on several factors such as material, shape, size and application. Porosity, fibre slippage and delamination are common place defects in composites which significantly influence their performance.

Infrared Thermography (IRT) is a widely used NDE technique for materials ranging from metals to composites and an array of application areas. IRT is particularly suitable for composites for detection of surface and subsurface defects specifically because it is a non-contact technique. One aspect where IRT scores over other NDE techniques is it can perform 100% inspection, even on large size structures, in much shorter time compared to other NDE techniques such as Ultrasonic and Radiography. This particular feature makes thermography extremely attractive for aerospace where quick and complete inspection is demanded by the quality system. Just like any other technique, IRT has its limitations too. It fails to detect deeper defects especially in composites and also the interpretation a shade subjective. These shortcomings have been overcome by several approaches which include corroborative findings through other techniques besides backing by experimental evaluation.

The purpose of this presentation is to bring out, in some detail, the application areas where IRT has been used as a NDE tool to study Quartz & Carbon composites with different resin systems. IRT performed on composites developed by a variety of processes and also in a range of shapes and sizes, some of them are large cylindrical structures, frustums of cones and open structures, revealed interesting observations. The study comprised of a combination of corroborative, investigative and experimental approach which has provided significant clues on errors in manufacturing which are otherwise obscure to the naked eye and also in establishing the process parameters to meet the objective performance, specifically in thermal structures. Finally, the study has helped in generation of basis for taking corrective action in manufacturing.