

2.3. NONDESTRUCTIVE TESTING OF COMPOSITE MATERIALS FOR MILITARY APPLICATIONS BY IR THERMOGRAPHY METHODS

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Non-destructive testing methods are used to detecting defects in materials and evaluation of materials properties without causing changes to their usable properties. They are applied in diagnostics and industry to provide the assurance of high quality for semi-manufactured products, final products, devices and construction. Except of many civilian applications they are widely used in rocket and aviation industry and also in many special military areas. Typical technical objects of non-destructive testing are different kinds of connections of materials (welded and soldered and glue joints etc.) as well as constructions and elements made from composite materials.

Composite materials are often more practical to be used for different military applications. These interesting materials are effective especially through their good strength properties, corrosion resistance and low specific weight. These materials have various structures. Any damage of these materials usually has a more complicated and other form than in metals and that is why methods and diagnostic techniques checked in metal constructions are often deceptive in constructions made from composite materials. The infrared thermography non-destructive testing methods prove to meet the expectations well in composite constructions. The main centre in Poland for research and development work on infrared thermography non-destructive methods is the Military Institute of Armament Technology (MIAT) where work is carried out for three groups of composite materials used in following areas: aviation, light ballistic protections and ammunition.

Aviation constructions with cellular filling structures are subjected to the risk of water penetration in the case of superficial discontinuities and lack of tightness. Due to flights at high altitudes and differences of temperatures and pressures, the water freezes causing delamination of the cover from the cellular filling material of these structures. This may affect the safety of flight. Even microscopic discontinuities of the material can cause the penetration of the water inside composite structures. They may be difficult to detect by non-destructive testing but the presence of moisture inside the composite structure creates a potential risk for defects. The fast detection of micro-defects can permit to avoid unexpected defects of aerospace elements. It means that detecting even small quantities of water inside a composite is essential.

The light ballistic protections are different type of composite materials which are tested by non-destructive IR thermography methods. Defects of light ballistic protections could be in result of hitting or firing. Different types of defects could be formed in process of production or in result of long-live use.

Defects in composite pyrotechnic materials and products can happen in production stage as well as in service time esp. during long-term storage. The diverse, changeable environmental conditions lasting in life cycles of pyrotechnic materials and products decide in considerably degree about their physicochemical characteristics such as thermal, mechanical parameters, stability, material compatibility and durability. In the paper both computer

simulations to define defects which could be detected using IR thermography method and selected experimental investigations are presented as well.

The paper contains a short review of the current and planned research work on the above mentioned subjects in MIAT.