TECHNOLOGY REPORT

Laser Technology Inc.

LASER SHEAROGRAPHY OF COMPOSITE AND HONEYCOMB COMPONENTS

Portable shearography systems generally are either tripod mounted (Fig. 1) or attached in some manner to the test object (Fig.2).

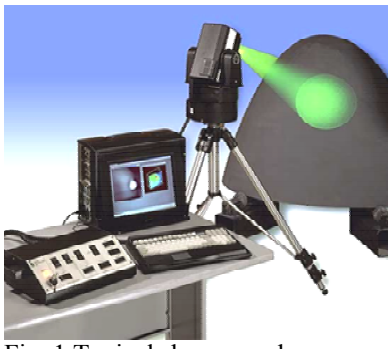

Fig. 1 Typical shearography camera system with built in laser, image processor and controls.

Fig. 2 Typical portable shearography system with built in laser and vacuum window

Portable system use laser diodes and various means such as vacuum changes, thermal flux or vibration to stress the object surface to detect subsurface anomalies. Shearography inspection of composite honeycomb engine reversers on the Airbus A330 using the LTI-4200. The structure is GRP face sheets with aluminum core. The inner surfaces are coated with a foam fire retardant material. Shearography indications in the sandwich structure, through the foam are routine. Defects indications are verified with secondary UT measurements requiring spot removal of the foam.

Shearography techniques using portable systems are excellent for engineered repairs in composite laminates. Fig. 3 shows a repair to an aircraft laminate with far side, bonded stringers (diagonal linear features). The repair uses scarf plies built up thicker than the original material, hence the signal from the stringers appears to disappear under the repair. Visible also are areas of porosity (circled in white). Test time is 15 seconds.

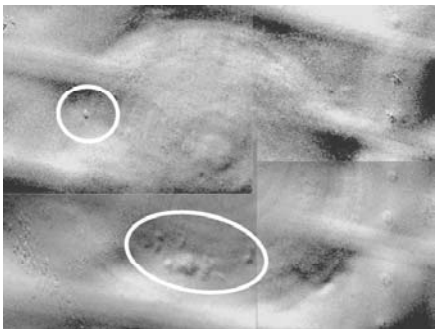

Fig. 3 Shearography image of engineered repair to a solid laminate aircraft structure with far side bonded stringers. Porosity is circled.

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Portable shearography systems have seen extensive use in aerospace and marine composite inspection since the introduction of the first systems in 1989. More than 170 composite boats and ships, including the Swedish Visby Naval Corvette ships measuring 73 meters. Portable shearography systems also recently were used to inspect the composite wind fairings covering the full 2,200 ft. length of the Bronx Whitestone.

Tripod mounted shearography cameras, Fig. 1, are used frequently with thermal stress shearography techniques. While thermography is sensitive to changes in surface temperature (or the derivatives of the temperature change), thermal shearography images changes in the thermal expansion of a structure Fig. 4. Damage, disbonds, FOD or delaminations produce local changes in the coefficient of thermal expansion. Thermal shearography is not generally effected by variations in emissivity or paint on the test part surface.

Fig. 4. Thermal shearogram of a Global Hawk aircraft fairing showing lay-up of the composite material. Thermal shearography is used for detection of disbonds and face sheet delamination.

First introduced on the USAF B-2 production program, gantry mounted shearography systems share many operational features with UT C-scan systems. These include: teach/learn part scan programming, electronic image of the entire part, image analysis and defect measurement tools, automated operation. Shearography system however operate at throughputs typically in the range of 100 to 500 sq. feet/hour compared to a typical throughput of 10 sq. ft./ hour for UT C-Scan systems. In addition, gantries are considerable less expensive since precision part contour following is unnecessary. Currently dozens of these systems are in operation on aerospace manufacturing programs

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Examples of Laser Shearography Images

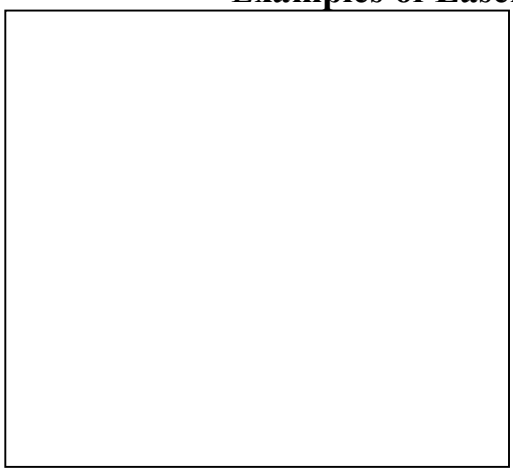

Fig. 5 Graphite Skin Metal Honeycomb with Disbond Shearogram Image

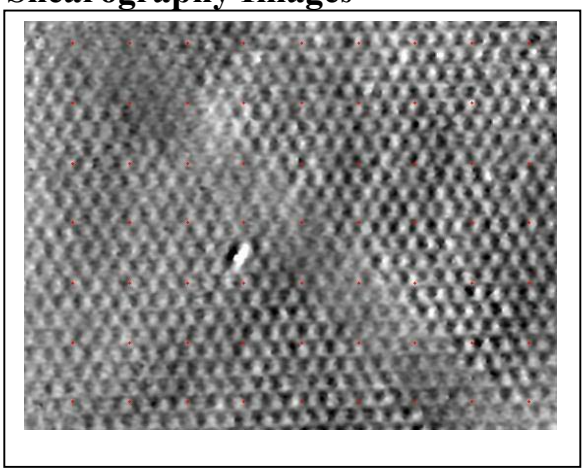

Fig.6 Aluminum core with Graphite Skin Shearography Image

Fig. 7 Aluminum core with Graphite Skin

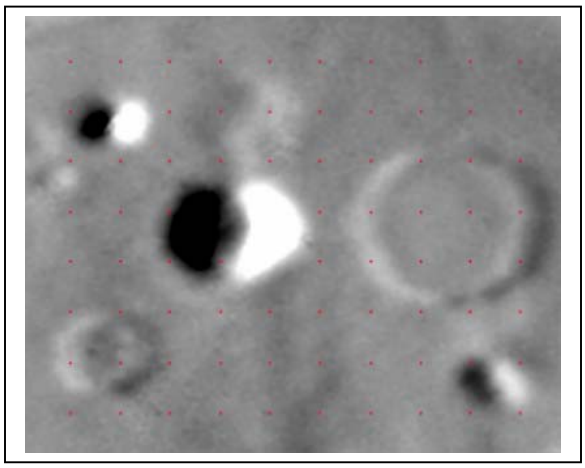

Fig. 8 AWACS Disbond and Repair Shearography Image

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