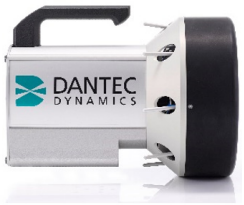
SOLUTION SHEET

FlawExplorer NDT System

Laser Shearography NDT System for fast & reliable inspection of sandwich, honeycomb, composite laminates (& overwraps), coatings & bondings, spray-foams & sealants, and ceramics & compounds



FlawExplorer Laser Shearography NDT Sensor side view.

FlawExplorer Laser Shearography NDT Sensor rear view.

Efficient & effective NDT Solution for in-field (service) NDT and quality control (post-production) operations

The FlawExplorer is a laser shearography non-destructive testing (NDT) sensor designed to be used for; post-production quality control applications or in-field component inspections. Depending on the application, the sensor can be configured with thermal or vacuum (partial) excitation systems and may also be automated. It incorporates the very latest in phase-shifting technology delivering accurate and reliable measurement results through clear and sharp imaging with sub-micrometer displacement resolution.

Key benefits

- Portable, easy to set up, and ready to operate within seconds
- Can inspect 3.4 m x 2.8 m (11.2 “ x 9.3 “) within a maximum of 25 seconds
- Compact, robust design featuring aluminum housing with a detachable safe-guard ring
- Uses the 4+4 Phase Shifting technique removing measurement noise
- Safe to use system with eight laser diodes of laser safety Class 3R
- Fully integrated control electronics
- Software controllable automatic shearing
- Automatic projection calibration
- Thermal or vacuum (partial) excitation system available

Sub-micrometer, measurement resolution

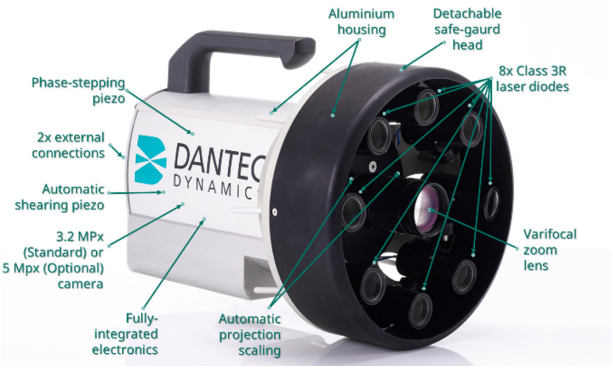
Laser Shearography is an optical, Non-Destructive Testing (NDT) technique used to reveal sub-surface defects in structures. This technique works through the application of a load to a structure for which a laser shearography sensor observes (minimal) surface bending in the form of an out-of-plane strain field, and subsequently images the measurement as a phase map. Since the sensor is sensitive to changes in the interference of laser light, the capability of the sensor to detect bending is within the sub-micrometer range.

The ultimate goal of any NDT system is to deliver reliable measurement results as economically as possible. Laser Shearography is a perfect solution that can detect defects that other NDT methods cannot, including disbonds, kissing bonds, node bond splits, and ply wrinkling. In many cases the reliability of the technique, as quantified through the smallest detectable defect size at 90% Probability of Detection (PoD) and low False Call Rates is unmatched. The economic advantages of using Laser Shearography include high inspection rates (i.e. m2/sec), low sample preparation times, and formal NDT technique approval & recognition. The best applications suited for the FlawExplorer are sandwich, honeycomb, composite laminates (& overwraps), coatings & bondings, spray-foams & sealants, and ceramics & compounds (cross-section) constructions.

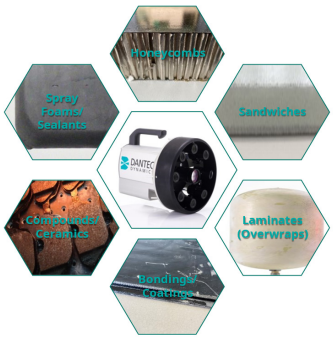
FlawExplorer Laser Shearography sensor with short-wave halogen thermal excitation presenting an Istra4D phase-map image of a composite overwrapped GFRP pressure vessel from Automotive NDT. The phase display presents two indications of ply wrinkling within the overwrap.

Fully integrated sensor with high-resolution imaging

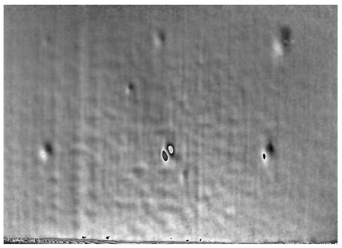
The FlawExplorer sensor is completely contained in one, lightweight (5 kgs / 11 lbs) unit. Only two connections are required to operate the sensor; one for power and one for camera data. With fully integrated imaging & control electronics, the sensor incorporates; a (standard) 3.2 MPx or (optional) 5 MPx, CMOS camera with a maximum frame rate of 37 & 24 Hz, respectively, a varifocal zoom lens, eight (Class 3R) laser diodes, automatic shearing, automatic projection calibration, and phase-shifting piezos. The sensor is contained in an aluminum housing with a detachable safe-guard ring, the rugged design of the FlawExplorer is designed to withstand shocks, knocks, and vibrations.



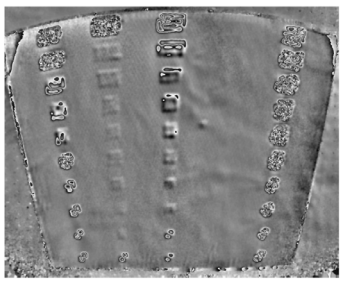
Schematic diagram of FlawExplorer sensor



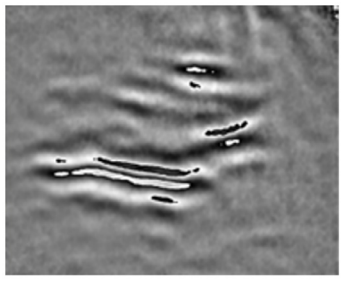
Applicable NDT Applications for Laser ShearograPhy



Phase Map of an Aramid Honeycomb Comp using the FlawExplorer (Aerospace NDT)



Phase Map of an Aluminum Honeycomb Comp using the FlawExplorer (Aerospace NDT)

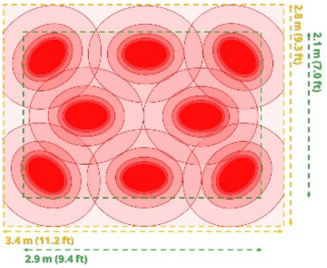


Phase Map of Ply Wrinkling of CFRP Laminate using the FlawExplorer (Wind Power NDT)

A workhorse for efficient & fast NDT inspection

Laser Shearography has one of the highest inspection rates compared to any NDT method, specifically because it utilizes a large Field-of-View (FoV) from the use of multiple coherent laser diodes. A FlawExplorer uses 8 laser diodes to generate a large illumination area = Field-of-View (FoV). For a standard 3.2 MPx camera, the achievable projected image size in one shot can be up to 2.9 m x 2.1 m (9.4 ft x 7.0 ft) or for an optional 5.0 MPx camera, up to 3.4 m x 2.8 m (11.2 ft x 9.3 ft) The inspection speed of the FlawExplorer is unmatched compared to any other NDT technique, delivering high throughput rates for time-saving inspections. Coupled with short loading times application, an inspection rate of multiple m² can be achieved per minute! This allows for faster and more economical NDT inspections.

The effectiveness (and also sensitivity) of Laser Shearography depends on the type of NDT inspection application and also the ability of the excitation technique to generate bending strain to the test object. At Dantec Dynamics we offer three different types of excitation systems; thermal excitation, vacuum (partial) excitation, and vacuum (ambient) excitation.



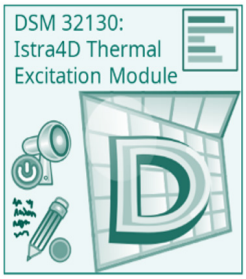
Inspection area of the FlawExplorer with a 3.2 MPx (standard) camera (green) or 5 MPx (optional) camera (yellow).

Thermal Excitation

A thermal Excitation is a form of loading that requires a heat source to create a change in surface temperature (ΔT) that induces a change in the out-of-plane bending. At Dantec Dynamics, we offer two different types of SW-controllable (infrared) heat lamps.

DSM 60074: Automatic Heat Excitation - Halogen Lamps with Halogen Short-Wave Bulbs, which have the highest radiation intensity and relatively short heating times. This solution is appropriate for; thick components more than 5 mm in thickness, testing at distances further than 80 cm to the object, and/or for the inspection of carbon-fiber and aramid-fiber laminates.

DSM 60072: Automatic Heat Excitation – Quartz Emitter Lamps consist of Medium-Wave Quartz Tungsten Emitters, which have an average radiation intensity, and moderate heating times, but are quite robust. This solution is appropriate for; thin components less than 5 mm in thickness, testing at distances less than 80 cm to the object, and/or for the inspection of glass-fiber laminates or bonded-components.



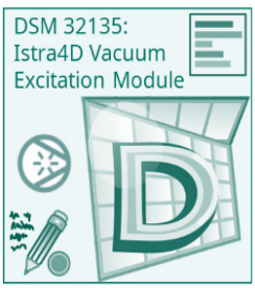
Istra4D Vacuum Excitation Module (required to operate DSM 60074 & DSM 60072)

DSM 60074 Automatic Heat Excitation: Halogen Lamps components

DSM 60072: Automatic Heat Excitation – Quartz Emitter Lamps components

Vacuum Excitation

Vacuum excitation is used to create negative pressure (suction/vacuum) by using a pump. This can be in two application forms, either as a surface section, whereby a manual vacuum hood (with a window) is used to cause the inspected surface to bend, or as a component, whereby a vacuum chamber causes entrapped gas within the sample to expand in all directions causing bending.



Istra4D Vacuum Excitation Module (required to operate DSM 61200)

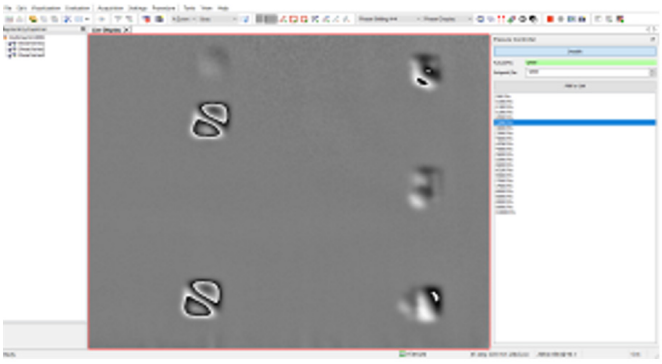
DSM 61200 & DSM 61210 Components

Istra4D – Laser Shearography

Istra4D, Dantec Dynamics' advanced laser shearography software, is intuitive and simple to use. With a clear user workflow, users have easy control of all relevant measurement configuration parameters, including; brightness, shearing, projection, and visualization settings. Users can easily perform real-time measurements and also advanced post-processing analysis of acquired results. Whatever the NDT application, Istra4D is the imaging workhorse behind all of Dantec's laser shearography systems.

To control the sensitivity of out-of-plane movement, the FlawExplorer includes a fully-automatic (software controlled) shearing piezo for both the shear angle and shear distance.

For reproducibility, the shearing piezo can be controlled with sub-pixel accuracy, ensuring that two measurements at different distances yield the same results.



Istra4D software presents a phase display map of multiple disbonds within an aluminum honeycomb component from the aerospace industry using manual vacuum control for vacuum (partial) excitation.

System Automation

A FlawExplorer system can be completely automated, including camera and heat triggering, display settings, filters, and control parameters. Whether mounted on a robotic arm, linear traverse, or an XY gantry, the sensor uses a dedicated communication protocol allowing complete interaction between the FlawExplorer software, Istra4D, and an autonomous PLC interface. Numerous successful automation projects for diverse NDT applications of Laser Shearography have driven the normalized requirement for robotic integration. This possibility is now available as a standard software module option, for complete reproducible testing.

FlawExplorer Laser Shearography Sensor mounted on a robotic arm.

NDT Applications

Customer Service & Support Benefits

1-year free software updates with technical support (E-mail/phone)

Unlimited access for an unlimited amount of users to the LS user training module via the Dantec eLearning platform.

User-exchangeable laser diode modules

Certificate of Calibration: phase shifter & automatic shearing.

1-year warranty (standard)

Access to a yearly servicing package at a fixed price, including Istra4D software upgrades.

Online help/support using Teamviewer™ for application assistance and running troubleshooting diagnostics online (if needed).

Dantec Dynamics works closely with accredited NDT training and servicing providers for Laser Sheargraphy NDT. Our primary training partner, Testia®, an Airbus® company, offers LS training to EN 4179 at Bristol in the UK. Certification can also be completed on location.

Technical specifications

Specifications	
Dimensions	316 mm x 218 mm x 233 mm (12.4 ” x 8.6 ” x 9.2 ”)
Weight	5 kg (11 lbs)
Camera	3.2 MPx / 37 Hz (standard) or 5 MPx / 24 Hz (optional)
Shearing Sensor	12-bit CMOS camera SW-controllable shearing piezo (shear angle and shear distance) Phase-stepping piezo Automatic projection scaling
Lens	Varifocal zoom lens (f=10-40mm)
Laser Unit	8 laser diodes / 120mW (CW) @ 660nm
Laser class	Class 3R Nominal Ocular Hazard Distance (NOHD): 27 cms (10.6 ’) DIN EN 60825-1:2007 / IEC 60825-1:2007 / ANSI Z136.1-2014

Technical specifications – Laptop PC

Specifications	
Standard LS Laptop	Intel® Core™ i7 Display: 15.6 “/ 16:9 / 1920 x 1080 (Full HD) RAM: 16 GB / SSD: 512 GB
Ruggedized LS Laptop	IEC 60529: IP-53 / MIL-STD-810G&H Intel® Core™ i7 Display: 14.0 “/ 16:9 / 1920 x 1080 (Full HD) RAM: 16 GB / SSD: 512 GB
Ultra-Ruggedized LS Laptop	IEC 60529: IP-65 / MIL-STD-810H / MIL-STD-461G Intel® Core™ i5 Display: 15.6 “/ 16:9 / 1920 x 1080 (Full HD) RAM: 8 GB / SSD: 500 GB

Order information

Category	Item	Item no
Sensor	FlawExplorer Laser Shearography Sensor	DSM 13180
Laptop PC	Standard LS Laptop	DSM 20130
	Ruggedized LS Laptop	DSM 20135
	Ultra Ruggedized LS Laptop	DSM 23000
Software (Istra4D)	Istra4D Software Platform	DSM 32000
	Istra4D Laser Shearography Module	DSM 32110
	Istra4D Thermal Excitation Module	DSM 32130
	Istra4D Vacuum Excitation Module	DSM 32135
	Istra4D Remote Automation Control Module	DSM 32150
Thermal Excitation	Automatic Heat Excitation - Quartz Emitter Lamps (*)	DSM 60072
	Automatic Heat Excitation - Halogen Lamps (*)	DSM 60074
Vacuum Excitation	Pressure Control Unit (**)	DSM 61200
	Standard Manual Vacuum Hood (***)	DSM 61210
Accessories	Standard Tripod	DSM 60030
	Pan/Tilt Motorized Head with Heavy-Duty Tripod	DSM 60036
	Tripod Dolly	DSM 60086
	Vacuum Tripod	DSM 60080
	Laser Safety Goggles (660 nm)	DSM 50050
	Membrane Demo Defect Sample	DSM 50210

(*) Requires the purchase of DSM 32130
(**) Requires the purchase of DSM 32135
(***) Requires the purchase of DSM 61200

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